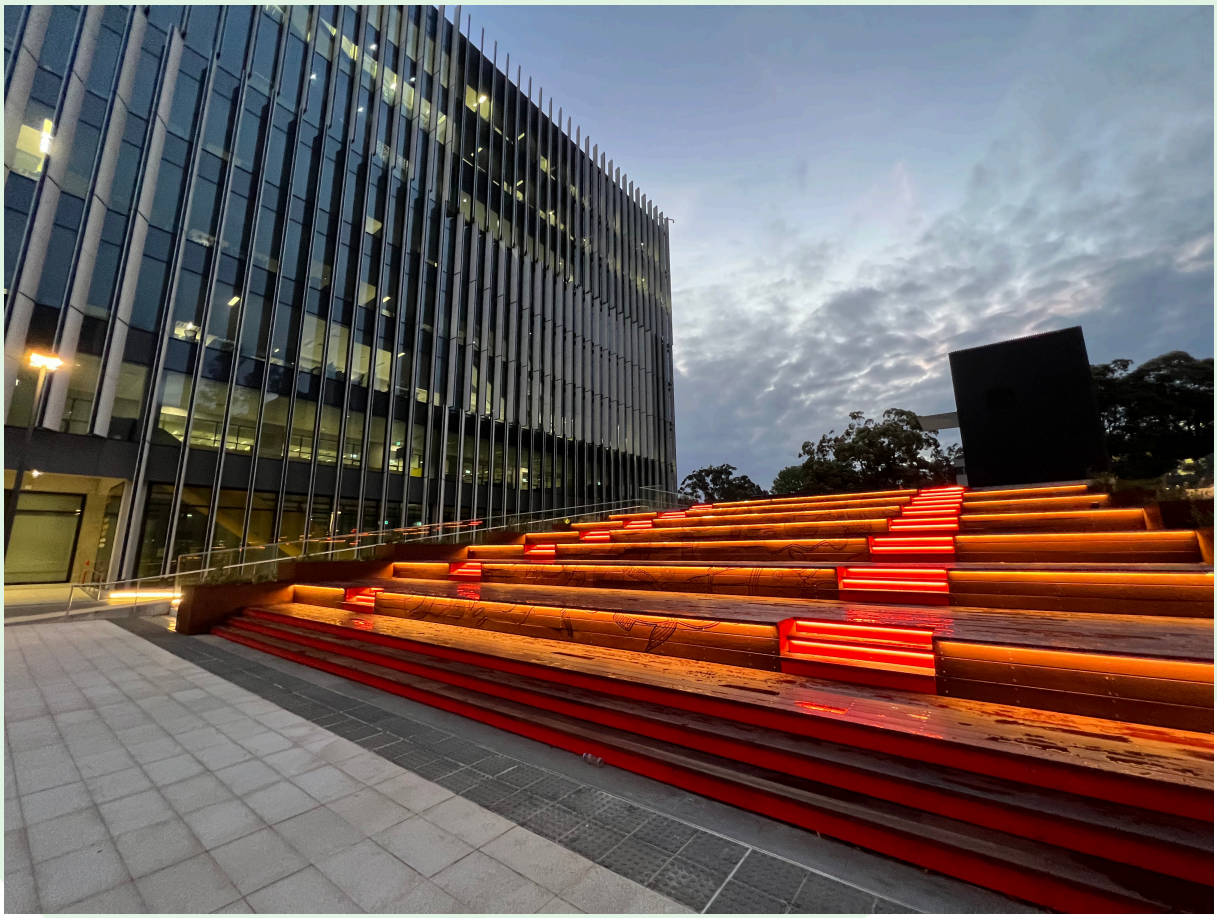
School of Chemical Engineering

UNSW Engineering

CEIC2000

Material and Energy Systems

Term 1, 2022



Course Overview

Staff Contact Details

Convenors

Name	Email	Availability	Location	Phone
Graeme Bushell	g.bushell@unsw.edu.au	Online consultation Tuesday afternoons 3pm-5pm	Hilmer 219	9385 5921

Lecturers

Name	Email	Availability	Location	Phone
Pierre Le Clech	p.le-clech@unsw.edu.au	Online consultation Tuesday afternoons 3pm-5pm	Hilmer 521	9385 5762

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.

If circumstances outside your control impact on submitting assessments, Special Consideration may be granted, usually in the form of an extension or a supplementary assessment. Applications for Special Consideration must be submitted online.

For course administration matters, please contact the Course Coordinator.

Course Details

Units of Credit 6

Summary of the Course

In this course students will learn sufficient thermodynamics and problem solution strategies to be able to apply thermodynamic concepts with material and energy balances to chemical process problems involving several unit operations and involving chemical reactions. This will include study of the first and second law of thermodynamics, vapour liquid equilibria for pure components, heats of phase change, heats of reaction and example applications such as refrigeration and power plants. This course is part of the chemical engineering design stream and thus culminates in a significant design exercise.

Textbook: Felder, R.M., and Rousseau, R.W., *Elementary Principles of Chemical Processes*, Wiley (any edition).

Course Learning Outcomes

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

Learning Outcome	EA Stage 1 Competencies
1. Apply thermodynamic concepts such as work, heat, enthalpy, entropy, and internal energy in chemical and process engineering context	PE1.1
2. Calculate changes in these thermodynamic variables for ideal gases and single component non-ideal fluids for simple unit operations (such as turbines, compressors, heat exchangers) and in reactive systems	PE1.1
3. Find and use tabulated and graphical representations of thermodynamic data	PE2.2
4. Calculate material and energy balances around single unit, multiunit, cyclical and reactive systems involved in common chemical process operations	PE2.1
5. Apply these abilities to chemical engineering design problems	PE2.3, PE3.6

Teaching Strategies

Please refer to the information in Moodle

Assessment

Individual assessment work is conducted via moodle using a "back to front" quiz. This means that the first question in the quiz is your final answer for the problem. The question is repeated on the second page with additional quiz questions that ask about your working. Because these questions provide additional guidance *that is not intended as part of the problem*, navigation backwards to the first page is disabled.

Assessment task	Weight	Due Date	Course Learning Outcomes Assessed
1. Final Exam	60%	As scheduled by exams unit	1, 2, 3, 4
2. Tests	20%	Weeks 1-5 and 7-9	1, 2, 3, 4
3. Tutorial Work	20%	Week 8 - 11	1, 2, 3, 4, 5

Assessment 1: Final Exam

Start date: Exam period
Assessment length: 3 hours
Submission notes: Online quiz for numerical answers and assignment tool for upload of working.
Due date: As scheduled by exams unit
Marks returned: After release of course marks

A final exam is given because the course learning outcomes include a significant level of technical learning that can be effectively assessed in an exam environment and because exams have high reliability. The final exam is closed book. The exam covers all of the parts of the course.

This is not a Turnitin assignment

Assessment criteria

Marks are awarded based on the types of errors made in modelling and calculation.

Assessment 2: Tests

Start date: Weekly
Assessment length: 1 hour
Due date: Weeks 1-5 and 7-9
Marks returned: Monday the following week.

The purpose is to give students frequent (weekly) yet small tests as feedback on their progression with the course. These will be conducted online and asychronously. The Tests will be conducted using the moodle quiz tool.

This is not a Turnitin assignment

Assessment criteria

Whether or not your numerical answers are correct (including how wrong they are).

Assessment 3: Tutorial Work

Submission notes: Submitted by one member of your team using assignment tools in moodle.
Due date: Week 8 - 11

Some of the tutorials work will be assessed, including in-tutorial design exercises in small teams.

This assignment is submitted through Turnitin and students can see Turnitin similarity reports.

Additional details

One member of your team ONLY to submit the team assignment via Turnitin. Make sure the names and student numbers of all contributors are listed on the assignment front page.

Attendance Requirements

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

Course Schedule

The course tutorials assume that you have already studied the lecture materials for that week. Please make sure you are prepared so that you don't waste your tutorial.

View class timetable

Timetable

Date	Type	Content
Week 1: 14 February - 18 February	Seminar	3 - 5pm Tuesday. Course orientation via Microsoft Teams (recorded).
	Online Activity	**Review lecture materials before your tutorial:** Batch and flow processes. Block flow diagrams. System boundaries. Components. Balance equations. Basic unit operations. Gas systems (ideal, real), Thermodynamic (property) tables, Vapor/liquid equilibrium. **Complete practice problems** (before or after tutorial, but before the weekly test).
	Tutorial	Material balances (2 hours), Thermodynamics (1 hour).
	Assessment	Week 1 test
Week 2: 21 February - 25 February	Online Activity	**Review lecture materials before your tutorial:** Degrees of freedom analysis. Basis and basis relocation. Processes with bypass and recycle loops. Forms of energy, first law of thermodynamics, internal energy, enthalpy. **Complete practice problems** (before or after tutorial, but before the weekly test).
	Seminar	3 - 5pm Tuesday. Informal help session via Microsoft Teams. Ask us anything - no pressure, no recording. MEB from 3-4, Thermo from 4-5.
	Tutorial	Material balances (2 hours), Thermodynamics (1 hour).
	Assessment	Week 2 test
Week 3: 28 February - 4 March	Online Activity	**Review lecture materials before your tutorial:** Mole balances and vapour / liquid phase

		equilibria. Including examples from humidification and drying, air conditioning (condensable and noncondensable components). Heat capacity, enthalpy calculations **Complete practice problems** (before or after tutorial, but before the weekly test).
	Seminar	3 - 5pm Tuesday. Informal help session via Microsoft Teams. Ask us anything - no pressure, no recording. MEB from 3-4, Thermo from 4-5.
	Tutorial	Material balances (1 hour), Thermodynamics (2 hours).
	Assessment	Week 3 test
Week 4: 7 March - 11 March	Online Activity	**Review lecture materials before your tutorial:** Stoichiometry and single units with reaction. Balances on Reactive Processes. Thermodynamics application to closed systems. **Complete practice problems** (before or after tutorial, but before the weekly test).
	Seminar	3 - 5pm Tuesday. Informal help session via Microsoft Teams. Ask us anything - no pressure, no recording. MEB from 3-4, Thermo from 4-5.
	Tutorial	Material balances (2 hours), Thermodynamics (1 hour).
	Assessment	Week 4 test
Week 5: 14 March - 18 March	Online Activity	**Review lecture materials before your tutorial:** Reaction problems with loops including recycle, bypass and purge. Per pass and overall conversion. Open systems and (un)steady states, Application to machines. **Complete practice problems** (before or after tutorial, but before the weekly test).
	Seminar	3 - 5pm Tuesday. Informal help session via Microsoft Teams. Ask us anything - no pressure, no recording. MEB from 3-4, Thermo from 4-5.
	Tutorial	Material balances (1 hour), Thermodynamics (2 hours).
	Assessment	Week 5 test
Week 6: 21 March - 25 March	Seminar	3 - 5pm Tuesday. Informal help session via Microsoft Teams. Ask us anything - no pressure, no recording. MEB from 3-4, Thermo from 4-5.

	Assessment	**Practice exam**. Exactly the same format as your final exam, except 1) the quiz windows are open instead of fixed by the exam schedule, and 2) only materials up to the end of week 5 are included.
Week 7: 28 March - 1 April	Online Activity	**Review lecture materials before your tutorial:** Introduction to energy balances including phase change. Calculating changes in enthalpy (with changing temperature, pressure and phase). The second law, Entropy for ideal gases, for real systems. **Complete practice problems** (before or after tutorial, but before the weekly test).
	Seminar	3 - 5pm Tuesday. Informal help session via Microsoft Teams. Ask us anything - no pressure, no recording. MEB from 3-4, Thermo from 4-5.
	Tutorial	Material balances (1 hour), Design (1 hour), Thermodynamics (1 hour)
	Assessment	Week 7 test
Week 8: 4 April - 8 April	Online Activity	**Review lecture materials before your tutorial:** Raoult's law, energy balances and non-ideal solutions. Enthalpy charts for vapour liquid equilibrium. Heat engine, Implication for reversible and irreversible processes. **Complete practice problems** (before or after tutorial, but before the weekly test).
	Seminar	3 - 5pm Tuesday. Informal help session via Microsoft Teams. Ask us anything - no pressure, no recording. MEB from 3-4, Thermo from 4-5.
	Tutorial	Material balances (1 hour), Design (1 hour), Thermodynamics (1 hour)
	Assessment	Week 8 test.
	Assessment	Week 7 tutorial work due
Week 9: 11 April - 15 April	Online Activity	**Review lecture materials before your tutorial:** Material and energy balances with chemical reaction. Single and sequential units. Two ways to handle heats of reaction. MEB problems with reaction. Machine efficiency, Carnot cycle. **Complete practice problems** (before or after tutorial, but before the weekly test).
	Seminar	3 - 5pm Tuesday. Informal help session via

		Microsoft Teams. Ask us anything - no pressure, no recording. MEB from 3-4, Thermo from 4-5.
	Tutorial	Material balances (1 hour), Design (1 hour), Thermodynamics (1 hour)
	Assessment	Week 9 test.
	Assessment	Week 8 tutorial work due
Week 10: 18 April - 22 April	Online Activity	**Review lecture materials before your tutorial:** Combustion with energy balance. LHV and HHV. Heats of mixing and solution. Unsteady-state material and energy balances. Refrigeration cycles **Complete practice problems** (before or after tutorial, but before the weekly test).
	Seminar	3 - 5pm Tuesday. Informal help session via Microsoft Teams. Ask us anything - no pressure, no recording. MEB from 3-4, Thermo from 4-5.
	Tutorial	Material balances (1 hour), Design (1 hour), Thermodynamics (1 hour)
	Assessment	Week 9 tutorial due
Study Week: 25 April - 28 April	Assessment	Week 10 tutorial work due

Resources

Prescribed Resources

Felder, R.M., Rousseau, R.W., and Bullard, L.G., "Elementary Principles of Chemical Processes", Wiley, Hoboken NJ, 2016.

This text is a primary means of access to course content and so students are encouraged to purchase their own copy. Multiple editions are available in the library, including electronic access (Leganto link provided in moodle).

We recommend that you purchase your own copy either second hand or from the bookshop, because the e-book license only allows a limited number of simultaneous users.

Course Evaluation and Development

Course evaluation and development feedback is welcome any time but is primarily sought through the myExperience survey run at the end of term.

Based on previous feedback, this term we have spent a lot of effort making what you need to do each week much clearer, and give you much more immediate feedback on your progress through the course with weekly tests.

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 generally not required; 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 due respect. Presenting results clearly gives the marker the best chance of understanding your method; even if the numerical results are incorrect.

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.

Late penalties

Unless otherwise specified, submissions received after the due date and time will be penalised at a rate of 5% per day or part thereof (including weekends). For some activities including Moodle quizzes and Team Evaluation surveys, extensions and late submissions are not possible.

Special consideration

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 submitting an assessment or sitting an exam.

UNSW has a Fit to Sit / Submit rule, which means that if you attempt an exam or submit a piece of assessment, 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.

Please note that students will need to provide some documentary evidence to support absences from any assessments missed because of COVID-19 public health measures such as isolation. UNSW will **not** be insisting on medical certificates for COVID-related absences of 7 days or less, with the positive PCR or RAT result being sufficient. Longer absences due to self-isolation or COVID-related illness will still need documentation such as a medical certificate.

Applications for special consideration **will still be required** for assessment and participation absences related to COVID-19. Special consideration requests should not be lodged for missing classes if there are no assessment activities in that class.

Academic Honesty and Plagiarism

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.

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.

Academic Information

To help you plan your degree, assistance is available from academic advisors in The Nucleus and also in the School of Chemical Engineering.

Additional support for students

- Current Student Gateway
- Engineering Current Student Resources
- Student Support and Success
- Academic Skills
- Student Wellbeing, Health and Safety
- Equitable Learning Services
- IT Service Centre

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.

On-campus class attendance

Physical distancing recommendations must be followed for all face-to-face classes. To ensure this, only students enrolled in those classes will be allowed in the room. Class rosters will be attached to corresponding rooms and circulated among lab demonstrators and tutors. No over-enrolment is allowed in face-to-face class. Students enrolled in online classes can swap their enrolment from online to a **limited** number of on-campus classes by Sunday, Week 1.

In certain classroom and laboratory situations where physical distancing cannot be maintained or the staff running the session believe that it will not be maintained, face masks will be designated by the course coordinator as **mandatory PPE** for students and staff. Students are required to bring and use their own face mask. Mask can be purchased from IGA Supermarket (Map B8, Lower Campus), campus pharmacy (Map F14, Middle Campus), the post office (Map F22, Upper Campus) and a vending machine in the foyer of the Biological Sciences Building (Map E26, Upper Campus).

Your health and the health of those in your class is critically important. You must stay at home if you are sick or have been advised to self-isolate by NSW health or government authorities. Current alerts and a list of hotspots can be found here. Do not come to campus if you have any of the following symptoms: fever (37.5 °C or higher), cough, sore throat, shortness of breath (difficulty breathing), runny nose, loss of taste, or loss of smell. If you need to have a COVID-19 test, you must not come to campus and remain in self-isolation until you receive the results of your test.

You will not be penalised for missing a face-to-face activity due to illness or a requirement to self-

isolate. We will work with you to ensure continuity of learning during your isolation and have plans in place for you to catch up on any content or learning activities you may miss. Where this might not be possible, an application for fee remission may be discussed. Further information is available on any course Moodle or Teams site.
For more information, please refer to the FAQs: https://www.covid-19.unsw.edu.au/safe-return-campus-faqs

Image Credit

Dr Peter Wich

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	✓