School of Chemical Engineering
UNSW Engineering

CEIC3000

Process Modelling and Analysis

Term 1, 2023

Course Overview

Staff Contact Details

Convenors

Name	Email	Availability	Location	Phone
Stuart Prescott	s.prescott@unsw.edu.au	Weekly Q&A sessions (within the scheduled lecture times)	Science and Engineering Building E8, Room 316a Hilmer	via Teams or email

Lecturers

Name	Email	Availability	Location	Phone
Priyank Kumar	priyank.kumar@unsw.edu.au	Weekly Q&A sessions (within the scheduled lecture times)	Science and Engineering Building E8, Room 334	via Teams or email

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.

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

Course Details

Units of Credit 6

Summary of the Course

The ever increasing global demand for better utilization of raw material and energy resources in an environmentally-sustainable manner means that greater ingenuity must be employed in the development of new processes (or improvement of existing ones). The traditional but time-consuming and expensive practice of first building a small-scale replica of the process for the sole purpose of investigating its dynamic and steady-state behaviour to acquire optimal operating conditions is a luxury that can no longer be afforded. Consequently, a more quantitative approach to process design and operation is now more attractive to industry.

Process modelling and analysis deals with the principles and methods for effectively building and understanding models of processes. This course is a central component of the chemical and process engineering curriculum and leads naturally to the principles of computer-based design and process control.

This course deals with the formulation of reliable mathematical models for the purpose of process design, control, and optimization. Through this course, you will therefore be equipped with skills in the derivation of linear and non-linear ODEs and PDEs based on the application of conservation laws to various chemical and biological processes. Analytical tools for the solution of linear and non-linear ODEs representing initial value and boundary value problems will be discussed. Illustrative examples involving lumped and distributed processes, discrete systems as well as multivariable (matrix) methods are included. Attention will be also given to nonlinear features identification including steady state multiplicity and bifurcation analysis. For situations where closed form solutions are unattainable, approximate methods are sought. Thus, the subject will also cover numerical methods for algebraic and ODEs. The use of numerical differentiation and interpolation in process analysis will also be examined.

Course Aims

The objectives of the course are to:

- Acquaint students with the skills to represent physical phenomena in mathematical/computational language by formulating models of different complexities depending on particular engineering needs, as well as with different techniques for mathematical model building, including, phenomenological and empirical approaches.

- Provide students with key mathematical, numerical, and computational methods useful for the analysis of wide-ranging chemical engineering problems.

- Integrate results from modelling exercises with known physicochemical features of the system to evolve better process design and operation.

- Acquaint students with the skills to model and understand the dynamic behaviour of physical and chemical processes

This course offers opportunities to refine your knowledge of other core subjects in a more analytical fashion, making further use of the chemical engineering and mathematics you have already studied.

Students will be able to consolidate your understanding and even draw extensions to other disciplines.

Course Learning Outcomes

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

Learning Outcome	EA Stage 1 Competencies
1. Identify the appropriate basis (e.g., assumptions and conditions) for developing mathematical models for use in chemical process engineering design.	PE1.3, PE2.1
2. Construct, solve, and analyse mathematical models of chemical engineering processes and process equipment using both analytical and numerical techniques.	PE1.3, PE2.1
3. Interpret and communicate the results of chemical process modelling experiments with a view to carrying out further refinement, utilisation for design, and optimisation of equipment and process designs.	PE3.2

Teaching Strategies

The instructional method employed in this course is informed by the need to stimulate a deep-approach to learning in the students. Recent educational research literature favours this approach, especially for application-oriented concepts frequently encountered in engineering. For that reason, we will provide the theoretical basis for the relevant analytical or numerical method. Illustrative examples will cut across a range of problems in thermodynamics, transport phenomena, kinetics, reactor design and separation processes. This will ensure that the student develops a knack for the nuances and intrigues unique to each approximation method.

In order to encourage a deep-approach to learning, emphasis is placed on the imbibition of mathematical concepts via problem-solving. Whilst theoretical foundation would be laid using principles illustrated in standard texts, lecture delivery is usually preceded by a qualitative description of why and where the concept(s) in question arise in natural systems and following the mathematical expose; applications to known chemical engineering and/or interdisciplinary processes are subsequently presented. The course is assigned 4 lecture hours per week, and 2 hours per week for problem solving workshops, but supplementation will be provided through assignment problems (which will be graded). Solutions will be given for the workshop questions. Note that supplementation of lecture material through these problem solving tasks ensures re-iteration of class concepts and/or how they can be manipulated depending on the intrigues of the particular problem. There is no need to worry as some of these twists are self-evident and you will get better at identifying and classifying them with experience – a major incentive for learning rather than mark-hunting!

Significantly, this approach ensures that the stated student learning outcomes can be more readily realised. For instance, our discussion on how ordinary linear and nonlinear differential equations arise in natural systems will enhance your ability to develop similar models for artificially-contrived scenarios in not only chemical engineering operations but also related disciplines – biomedical, materials processing and even finance/stock-broking industry.

Additional Course Information

Requisite knowledge and relationships to other courses

This course is about mathematical model design, implementation and solution. It builds upon the skills base laid in second year mathematics and numerical methods, the conceptual chemical engineering principles from CEIC2001 (Fluid and Particle Mechanics), CEIC2002 (Heat and Mass Transfer) and CEIC2005 (Chemical Reaction Engineering) and the engineering design process from DESN1000/ENGG1000 (Introduction to Engineering Design and Innovation) and CEIC2000 (Material and Energy Systems). The learning from this course is utilised in CEIC3005 (Process Plant and Design), CEIC3006 (Process Dynamics and Control) and CHEN6706 (Advanced Transport Phenomena). The mathematical tools from MATH2019/MATH2018 and MATH2089 are required to simplify and solve differential equations both analytically and numerically.

The purposes of the course are to increase the strength of students' mathematical skills and abstract thinking and to help them appreciate process analysis and synthesis. This is the first course in chemical engineering where students really consider processes in unsteady-state. It should be seen as a much more mathematical progression of CEIC2002/CEIC2005 and so these courses closely linked. The course will show you mathematical, numerical and computational techniques for creating models of processes.

Expectations

Integrity and Respect

The UNSW Student Code of Conduct (https://student.unsw.edu.au/conduct) among other things, expects all students to demonstrate integrity in all the academic work and to treat all staff, students and visitors to the University with courtesy, tolerance and respect.

Time commitment

UNSW expects students to spend approximately 150 hours to successfully complete a 6 UOC course like CEIC3000. We expect 60 hours to be spent participating in self-paced lessons and face-to-face lectures where you will see the theory and some first uses of it on problems, 10 hours working on the workshop questions outside of class where you will practice problems and understand what questions to ask in the workshops, 10 hours completing the two assignments, 6 hours completing the mid-term test and the final exam, with the remaining 64 hours provided for private study each week and preparation for the examinations. The summary is that outside class, you should be spending at least 7 hours per week working on CEIC3000. We've found that omitting the effort in weeks when assignments aren't due leads to big bubbles of work in the weeks when the assignments due as there is then an impossible task to catch up.

Competence

Students are expected to enter CEIC3000 having developed competencies in all the material covered in the pre-requisite courses, at least. Little time is available to remediate any deficiencies in your knowledge of those topics. Over the course of the term, you will be developing new competencies and to illustrate the standards we expect, marking rubrics or guidelines will be provided for all assessments. The teaching staff will apply these marking guides fairly and provide you with feedback so you can continue to improve over the term and beyond.

Participation

When you attend face-to-face classes, we expect you to actively participate in the activities organised. This may mean listening, taking notes, asking questions or engaging in peer discussions. It may also mean working by yourself or in groups on workshop exercises.

Students are expected to contribute to online discussions in Microsoft Teams. You may wish to discuss challenges faced through this course, ask questions about course content, discuss solutions to workshop and practice questions. It is expected that students will help each other, and the lecturers will contribute as required.

Attendance and punctuality

We expect students to be punctual and attend at all lectures and workshops. University commitments take precedence over regular work activities, holidays etc. Students who attend less than 80% of their possible classes may be refused final assessment. If you miss a class, we expect you to catch up in your time, lectures will be recorded and made available through Moodle, but remember that recorded lectures are a poor substitute for being there and participating.

Assessment

Assessment task	Weight	Due Date	Course Learning Outcomes Assessed
1. Assignment 1: Developing Models	15%	Friday, Week 4	1, 2, 3
2. Assignment 2: Analysing Models	15%	Friday, Week 9	1, 2, 3
3. Mid-Session Exam	25%	Monday, Week 7	1, 2, 3
4. Final Exam	45%	Exam Period	1, 2, 3

Assessment 1: Assignment 1: Developing Models

Submission notes: via Moodle
Due date: Friday, Week 4

In this assignment, you will develop models and solve them, applying insight from the analytical and numerical modelling to simplified design problems. This assignment is designed to let you demonstrate your achievements in the first half of the course, developing models from first principles, simplifying them to make them tractable, applying sophisticated mathematical techniques to find steady state solutions, and using numerical methods to investigate the problem.

Templates for the numerical methods sections of the assignment will be provided.

Additional details

On-going participation in the online lessons and face-to-face workshops will accrue up to 1 bonus mark within this activity.

Assessment 2: Assignment 2: Analysing Models

Submission notes: via Moodle
Due date: Friday, Week 9

In this assignment, you will develop models of systems based on the underlying physics of the situation and analyse them, applying insight from the analysis to simplified design problems. This assignment will allow you to demonstrate your knowledge of the second half of the course in analysing models and how that can be used to understand the real system that they represent.

Templates for the numerical methods sections of the assignment will be provided.

Additional details

On-going participation in the online lessons and face-to-face workshops will accrue up to 1 bonus mark within this activity.

Assessment 3: Mid-Session Exam

Start date: 27/03/2023 09:00 AM
Submission notes: In person. Details TBA.
Due date: Monday, Week 7

Progress test on course to date. The mid-session examination will cover all of the material from the first 6 weeks of the course. You will be asked to develop models, simplify them, use integration or steady-state approximations to see deeper insights into the model, make approximations to simplify models, and analyse models.

Additional details

The mid-session exam will be held during the scheduled lecture time. It will be an in-person, invigilated exam. Further details will be announced.

Assessment 4: Final Exam

Submission notes: In person. Details TBA.
Due date: Exam Period

In this final examination, with questions assessing the entire course, you'll demonstrate your skills in developing models, simplifying them, integration techniques, model analysis, linearisation, phase portraits and numerical methods.

Additional details

The final exam will be held during the exam period. It will be open book and a laptop computer will be needed to complete parts of it. Further details will be announced closer to the exam period and a sample paper will be provided.

Attendance Requirements

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

Course Schedule

This course has a combination of timetabled classes and self-paced learning activities. Completing the relevant self-paced learning activities each week (or better, the week before!) will help you keep up with the material and get the most out of the timetabled classes. There will be a couple of the timetabled classes that are not needed (they are spares for public holidays or other disruptions), so you can use those times to work on some of the self-paced lessons.

The face-to-face workshop sessions cannot be recorded and the lecture recordings are not an adequate substitute for attending the lectures.

View class timetable

Timetable

Date	Type	Content
O-Week: 6 February - 10 February	Online Activity	1. Welcome video with important course info 2. Get yourself set up for numerical methods with either Python or Matlab 3. Revise material from CEIC2002 (heat transfer and mass transfer), CEIC2005 (kinetics and reaction engineering), MATH2089 (numerical methods for ODEs, linear algebra, plotting functions), MATH2018/2019 (advanced integration), MATH1231 (linear algebra), ENGG1811 (functions and loops)
	Online Activity	Brief revision and refamiliarisation with numerical methods in Python or Matlab
Week 1: 13 February - 17 February	Lecture	(Monday) Process modelling: Introduction and basic ingredients
	Online Activity	Learning about setting up models
	Workshop	Application of basic ingredients to situations
	Lecture	(Thursday) More on basic ingredients of modelling
Week 2: 20 February - 24 February	Lecture	(Monday) How to formulate physicochemical problems
	Online Activity	Different physicochemical scenarios
	Workshop	Setting up and formulating example problems

	Lecture	(Thursday) How to formulate physicochemical problems: Examples
Week 3: 27 February - 3 March	Lecture	(Monday) First-order differential equations: Selected topics
	Online Activity	Case studies in process modelling
	Workshop	Building models, solving and analysing them
	Lecture	(Thursday) First-order differential equations: Example physicochemical problems
	Homework	Work on Assignment 1 (see details in Assessments section)
Week 4: 6 March - 10 March	Lecture	(Monday) Second-order differential equations: Selected topics
	Lecture	(Thursday) Second-order differential equations: Example physicochemical problems
	Online Activity	Additional case studies in process modelling
	Workshop	Building models, solving and analysing them
	Homework	Finalise Assignment 1 (see details in Assessments section)
Week 5: 13 March - 17 March	Lecture	(Monday) Constructing dynamic models. Approach to steady state.
	Online Activity	Using linear algebra for modelling
	Lecture	(Thursday) Dynamics in chemical engineering
	Workshop	More complex problems and modelling real processes
Week 6: 20 March - 24 March	Lecture	No lectures in Flexibility Week - this is a chance for extra revision and consolidation of material from CEIC3000 and also its prerequisite courses.
	Online Activity	Revision of some linear algebra for analysing models
	Workshop	Revision of setting up and solving complex models
	Homework	Revision of material from weeks 1-6 (i.e. including dynamics from week 5) for mid-session test.
Week 7: 27 March - 31 March	Assessment	(Monday) Mid-session exam (see details in Assessments section)
	Lecture	(Thursday) Linear systems analysis. Stability.

		Normalisation.
	Online Activity	1. More on formulating problems with linear algebra 2. Linear algebra and 'transformations'
	Workshop	Stability, classification, impulses.
Week 8: 3 April - 7 April	Lecture	(Monday) Phase space, characteristic directions, characteristic speeds.
	Online Activity	More sketching phase portraits
	Workshop	Sketching phase protraits and interpreting their meaning
	Online Activity	1. Linearisation of nonlinear problems 2. Perturbations 3. Phase portraits for non-linear systems
	Homework	Work on Assignment 2 (see details in Assessments section)
	Lecture	(Thursday) Linear and Non-linear problems in chemical engineering
Week 9: 10 April - 14 April	Lecture	(Monday) No lecture: Easter Monday Public Holiday
	Online Activity	Getting more detailed qualitative information from phase portraits
	Lecture	(Thursday) Bifurcations 1. Pitchfork, Hopf bifrucations. Lorenz model of convection.
	Workshop	Linearisation and more complicated phase portraits
	Homework	Finalise Assignment 2 (see details in Assessments section)
Week 10: 17 April - 21 April	Lecture	(Monday) Bifurcations 2. saddle-node and transcritical bifurcations. Multiplicity.
	Workshop	Bifurcation examples, finding bifurcations, analysing problems aroud bifurcation points
	Lecture	(Thursday) Case studies, summary, reflections on process modelling, final exam discussion.

Resources

Prescribed Resources

1. Rice, R. G. and Do, D.D., Applied Mathematics and Modelling for Chemical Engineers, John Wiley, 1995. (e-book available from library, see links in Moodle).
   This book provides additional support and information for the first half of the course. Parts of the book are more advanced than required in CEIC3000.
2. Bird, RB 2014, Introductory Transport Phenomena, John Wiley & Sons, Incorporated, New York. (e-book available from library, see links in Moodle)
   This book provides a combination of revision of transport phenomena plus their modelling. This book supports all of CEIC3000; parts of this book are more advanced than required in CEIC3000.
3. Modelling and Analysis CEIC3000 Course Notes, S.W. Prescott, J. Bao, and B.W. Bequette. (e-book available via Moodle).
   These course notes were edited specifically for the second half of CEIC3000 and provide a reference for the underpinning theory that complements the lectures. Everything in these notes is part of the second half of CEIC3000.

Recommended Resources

Additional e-books on numerical computing for engineers are provided via Moodle, with books covering both Python and Matlab available.

Course Evaluation and Development

The School of Chemical Engineering evaluates each course each time it is run through (i) myExperience Surveys, and (ii) Focus Group Meetings. As part of the myExperience process, your student evaluations on various aspects of the course are analysed; the Course Coordinator prepares a summary report for the Head of School. Any problem areas are identified for remedial action, and ideas for making improvements to the course are noted for action the next time that the course is run. Focus Group Meetings are conducted each term. Student comments on each course are collected and disseminated to the Lecturers concerned, noting any points which can help improve the course.

Recent changes made to the course are described on Moodle.

Laboratory Workshop Information

This course makes extensive use of numerical methods. You can complete it using Python (with the numpy/scipy packages) or Matlab. These are available via either CoCalc.com or myAccess.

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.

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) and will not be accepted more than 5 days late. For some activities including Exams, Quizzes, Peer Feedback, 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 for **all** special consideration requests (including COVID-19-related requests), students will need documentary evidence to support absences from any classes or assessments.

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.

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	Unacceptable 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	✗ asking for help with 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.

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 for information about key dates, access to services, and lots more information
- Engineering Student Life - Current Student Resources for information about everything from getting to campus to our first year guide
- Student Support and Success for our UNSW team dedicated to helping with university life, visas, wellbeing, and academic performance
- Academic Skills to brush up on some study skills, time management skills, get one-on-one support in developing good learning habits, or join workshops on skills development
- Student Wellbeing, Health and Safety for information on the UNSW health services, mental health support, and lots of other useful wellbeing resources
- Equitable Learning Services for assistance with long term conditions that impact on your studies
- IT Service Centre for everything to do with computing, including installing UNSW licensed software, access to computing systems, on-campus WIFI and off-campus VPNs

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 suceed. 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 fullfilling 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

In 2023, most classes at UNSW are running in a face-to-face mode only. Attendance is expected as is participation in the classes. 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.

This course outline will have further details in the Course Schedule and Assessment sections.

Class numbers are capped in each class to ensure appropriate facilities are available, to maintain student:staff ratios, and to help maintain adequate ventilation in the spaces. Only students enrolled in each specific 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 classes.

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 have COVID-19 or have been advised to self-isolate by NSW health or government authorities.

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.

Note: 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

Pilot Hall with experiment rigs // UNSW Chemical Engineering

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	