



UNSW Course Outline

CEIC4001 Process Design Project - 2024

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General Course Information

Course Code : CEIC4001

Year : 2024

Term : Term 1

Teaching Period : T1

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 : Undergraduate

Units of Credit : 12

Useful Links

[Handbook Class Timetable](#)

Course Details & Outcomes

Course Description

This is a capstone Chemical Engineering course involving the design of part or all of a process plant. You will work in a team to respond to a design brief developed in consultation with industry partners focusing on sustainability and the circular economy for real-world operations. Preparing

your design will involve you applying and integrating your learning from the entire undergraduate Chemical Engineering stream involving technical, economic, environmental and societal considerations.

The project will involve you working through various phases of design according to professional expectations and industry standards. First, you will define the design problem, generate and evaluate conceptual products and/or processes, and prepare a preliminary design and costing. Then you will prepare detailed equipment selection and sizing, as well as developing a control system to manage hazards identified through your risk register and hazard and operability (HAZOP) study. Lastly, you will finalise process equipment and plant layout, evaluate and control environmental impacts, and evaluate the economic viability of the plant. Alongside the design work, you will apply and extend your professional skills and lifelong learning skills in team work, communication, decision making, leadership and project management.

Course Aims

This course allows students to demonstrate their competence in the basic tasks that constitute the design process as practiced by chemical engineers. Students will experience the complexity of significant design projects – particularly, that there is often more than one good solution to a design problem, and that technical constraints are rarely the biggest factor affecting design choices. Consequently, students are expected to complete their design work using creativity and judgement (as well as trade-offs and compromises), while respecting that the boundaries of environmental and process safety cannot be crossed.

Relationship to Other Courses

Process Design directly builds on CEIC3004, CEIC3005 and CEIC3006, and on many other fundamental aspects of Chemical Engineering taught during the program. These courses cover the core design subjects of developing flowsheets, designing and estimating the size of unit processes, estimating capital and operating costs, determining the return on investment, simulation a chemical process, the basics of process control and the development of P&ID's and identifying and managing potential hazards. The course also requires an ability to develop chemical pathways, design reactor vessels and implement appropriate separation and purification steps for common industrial processes.

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Generate a suite of conceptual engineering solutions to meet a functional brief
CLO2 : Select a conceptual engineering solution and perform detailed design for a project including layout, sizing, costing, control, and safety systems
CLO3 : Identify and cost measures to mitigate negative social and environmental impacts and ensure that the engineering project will not cause harm to people or damage to buildings, infrastructure, or the environment
CLO4 : Develop and synthesise the key aspects of the engineering design to assess and communicate a recommendation on technical and financial feasibility of the project in written, graphical and verbal forms.

Course Learning Outcomes	Assessment Item
CLO1 : Generate a suite of conceptual engineering solutions to meet a functional brief	<ul style="list-style-type: none">• Design Interviews• Design Reports
CLO2 : Select a conceptual engineering solution and perform detailed design for a project including layout, sizing, costing, control, and safety systems	<ul style="list-style-type: none">• Design Interviews• Design Reports
CLO3 : Identify and cost measures to mitigate negative social and environmental impacts and ensure that the engineering project will not cause harm to people or damage to buildings, infrastructure, or the environment	<ul style="list-style-type: none">• Design Interviews• Design Reports
CLO4 : Develop and synthesise the key aspects of the engineering design to assess and communicate a recommendation on technical and financial feasibility of the project in written, graphical and verbal forms.	<ul style="list-style-type: none">• Design Interviews• Design Reports

Learning and Teaching Technologies

Moodle - Learning Management System

Learning and Teaching in this course

Available on Moodle.

Other Professional Outcomes

Engineers Australia, Professional Engineer Stage 1 Competencies

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

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.

PE2.3 Application of systematic engineering synthesis and design processes.

PE2.4 Application of systematic approaches to the conduct and management of engineering projects.

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.

PE3.6 Effective team membership and team leadership.

Additional Course Information

This course considers the design of all or part of a process plant. It requires the application of material covered in the entire undergraduate Chemical Engineering /Industrial Chemistry program. Students apply the experience gained in the preceding years of study to a given problem in order to develop technical and non-technical aspects of a particular solution. While the students are required to develop the skills required for professional accreditation, the students are also encouraged to develop skills in areas of specialisation or interest related to the broad design issues for the selected project.

The project includes: conceptual design of a process; development and evaluation of the process flow sheet; design of facilities for processing, transport and storage of materials within the plant; plant sizing; equipment selection and cost estimation including utility requirements; plant location and layout; evaluation of economic viability of the plant; control scheme development; hazard and risk assessment; preparation of a piping and instrumentation diagram. The students will have the opportunity to develop skills in teamwork, interpersonal relationships, decision making and technical capabilities.

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Design Interviews Assessment Format: Individual	45%	Due Date: Week 3, Week 8, Week 11
Design Reports Assessment Format: Individual	55%	Due Date: Week 5, Week 9, Week 11

Assessment Details

Design Interviews

Assessment Overview

Students will participate in several group and individual interviews during the regular and exam period to review the progress and quality of their designs. Each interview will consist of a brief presentation followed by extended time for questions. The interviews provide feedback on design work that can be applied in the associated report submissions. Students will be individually marked for all interviews.

Course Learning Outcomes

- CLO1 : Generate a suite of conceptual engineering solutions to meet a functional brief
- CLO2 : Select a conceptual engineering solution and perform detailed design for a project including layout, sizing, costing, control, and safety systems
- CLO3 : Identify and cost measures to mitigate negative social and environmental impacts and ensure that the engineering project will not cause harm to people or damage to buildings, infrastructure, or the environment
- CLO4 : Develop and synthesise the key aspects of the engineering design to assess and communicate a recommendation on technical and financial feasibility of the project in written, graphical and verbal forms.

Assignment submission Turnitin type

This is not a Turnitin assignment

Design Reports

Assessment Overview

Students will prepare series of group and individual reports at the completion of each phase of the project. The reports will build on the topics discussed and feedback received during the previous meetings and interviews, but present the design work in significantly more detail. Marks for group reports will be moderated to reflect individual contributions and quality using a peer-

feedback mechanism.

Course Learning Outcomes

- CLO1 : Generate a suite of conceptual engineering solutions to meet a functional brief
- CLO2 : Select a conceptual engineering solution and perform detailed design for a project including layout, sizing, costing, control, and safety systems
- CLO3 : Identify and cost measures to mitigate negative social and environmental impacts and ensure that the engineering project will not cause harm to people or damage to buildings, infrastructure, or the environment
- CLO4 : Develop and synthesise the key aspects of the engineering design to assess and communicate a recommendation on technical and financial feasibility of the project in written, graphical and verbal forms.

Assignment submission Turnitin type

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

General Assessment Information

Assessment includes:

- Group interview 1 (Technical Feasibility: Option Evaluation), By arrangement with mentor in Week 3 (10 individual)
- Group Report 1 (Technical Feasibility: Option Evaluation; selected process narrative and Process Flow Diagram (PFD), Mass & Energy Balance), Friday 9pm, Week 5 (20 Group)
- Individual report and interview (Individual process: Equipment Sizing; Process Simulation; P&ID, Hazard Analysis (HAZOP); Process control table), Interview: By arrangement with mentor in Week 8; Report: Tuesday 9pm, Week 9 (Interview: 10 Individual, Report: 20 Individual)
- Group Report 2 (Financial Viability & Environmental Impact (+ plant layout)), Thursday, 9pm, Week 11 (15 Group)
- Group Interview 2 (Interview with industry panel (90 min)) Tuesday 7th May (10 Group, 10 Individual)
- Rejoinder for final report (Change log to include comments from mentors and interview) 8th May, 9pm (5 Group)

Notes:

- Your final mark is based on a group and individual components. You must pass each component to pass the course (score >50% on both individual and group components).
- All submissions will be marked by your academic mentor according to specific marking schemes, available on Moodle.
- By default, email the report to your mentor by the deadline. Other “delivery” arrangements could be organized, but the timeline is final. If needed, special consideration could be requested through the official process (<https://student.unsw.edu.au/special-consideration>). Please email the course coordinator and your mentor on your situation as soon as possible.

- A more detailed breakdown of the elements of each report along with the marking scheme will be distributed in week 1.
- The schedule for CEIC 4001 is very tight and it is recommended that a continuous effort is made throughout the session. Each group will be assigned an academic mentor to offer advice and guidance for each report. Each group is responsible for arranging a weekly meeting with their academic mentor.

Grading Basis

Standard

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 12 February - 18 February	Seminar	Welcome and introduction to project. Free lunch included!
Week 2 : 19 February - 25 February	Seminar	Guest lecture from the industry partner. Learn where the wastewater comes from and current management of the stream.
Week 3 : 26 February - 3 March	Seminar	Getting ready for Group interview 1
	Presentation	Interview with Mentor
Week 4 : 4 March - 10 March	Seminar	Design documentation, MEB through to P&ID
Week 5 : 11 March - 17 March	Seminar	How to complete Report 1
	Assessment	Group report #1 due on Friday
Week 6 : 18 March - 24 March	Seminar	Preparing for individual interviews
Week 7 : 25 March - 31 March	Seminar	General Q&A
Week 8 : 1 April - 7 April	Seminar	Preparing for individual interview and report
	Presentation	Interview with Mentor about individual design
Week 9 : 8 April - 14 April	Assessment	Individual report due on Tuesday
Week 10 : 15 April - 21 April	Seminar	Preparing for final report and group interviews
Week 11 : 22 April - 28 April	Assessment	Second group report due on Thursday - Week 11
	Assessment	Group interview with industry panel: Tuesday 7th May, between 8.30am to 1pm. Free lunch and awards ceremony from 1pm.
	Assessment	Final recommendations and rejoinder due on Wednesday 8th May, 9pm.

Attendance Requirements

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

General Schedule Information

This course features a weekly class seminar on Mondays and your group will have the opportunity to meet your mentor for one hour each week.

This is a very intense course, and you are encouraged to start working on the project from O-Week. All information about the project is available on Moodle from O-Week and the students are encouraged to browse through the teaching materials and start brainstorming ideas with their team members.

Course Resources

Prescribed Resources

None.

Recommended Resources

A number of resources will be posted on Moodle. In addition, you can refer to the textbooks available under the "reading list" tab on Moodle for help on different aspects of process design.

Additional Costs

None.

Course Evaluation and Development

Course evaluation and development feedback is welcome any time and you are encouraged to talk to your mentor or the course coordinator during the course. In addition, feedback is primarily sought through the myExperience survey run at the end of term.

Based on previous feedback, we have spent a lot of effort describing in details the expectations for each assignment (through clearer marking rubrics), and give you much more immediate feedback on your progress during the interviews.

Recent changes include the reweighting of marks between interviews and reports, and between group reports 1 and 2 so to better recognise the work done by the students. All assessment details and marking criteria are now provided at the beginning of the course so to better understand the tasks ahead.

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	Pierre Le-Clech		Science and Engineering Building (SEB), 532	293855762	Mondays 2-4 or by appointment	No	Yes

Other Useful Information

Academic Information

I. Special consideration and supplementary assessment

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

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

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

II. Administrative matters and links

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

- [Attendance](#)
- [UNSW Email Address](#)
- [Special Consideration](#)
- [Exams](#)
- [Approved Calculators](#)
- [Academic Honesty and Plagiarism](#)
- [Equitable Learning Services](#)

III. Equity and diversity

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

IV. Professional Outcomes and Program Design

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

Note: This course outline sets out the description of classes at the date the Course Outline is published. The nature of classes may change during the Term after the Course Outline is published.

Moodle or your primary learning management system (LMS) should be consulted for the up-to-date class descriptions. If there is any inconsistency in the description of activities between the University timetable and the Course Outline/Moodle/LMS, the description in the Course Outline/Moodle/LMS applies.

Academic Honesty and 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 a specific 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 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 this course should normally be asked during the scheduled class so that everyone can benefit from the answer and discussion.