



Faculty of Engineering and Applied Science

CHEE 321 – CHEMICAL REACTION ENGINEERING

Course Syllabus – Fall 2021

This is your course syllabus. Please download the file and keep it for future reference.

LAND ACKNOWLEDGEMENT

Queen's University is situated on traditional Anishinaabe and Haudenosaunee Territory.
See: <http://www.queensu.ca/encyclopedia/t/traditional-territories>

INCLUSIVITY STATEMENT

Queen's students, faculty, and staff come from every imaginable background – small towns and suburbs, urban high rises, Indigenous communities, and from more than 100 countries around the world. You belong here: <https://www.queensu.ca/inclusive/>.

TEACHING TEAM

COURSE INSTRUCTOR

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CHEE321 (F 3-0-0.5 3.5)

COURSE DESCRIPTION¹

This course provides a detailed and in-depth analysis to the principles of chemical kinetics, and reactor analysis and design. The topics in chemical kinetics include: rate constants, reaction order, rate equations for elementary and complex reactions, kinetic data analysis, and product distribution. In reactor analysis and design, discussion is focused on ideal reactor systems and arrangements, including batch reactors, plug flow reactors, continuous stirred tank reactors, and recycle reactors. The last part of the course considers homogeneous and heterogeneous catalytic reactions. The design component consists of how to make an appropriate choice of reactor type and operating conditions to optimize a desired product; sizing such reactors and determining conversion levels under various conditions of temperature and pressure; determination of reaction kinetics from experimental data.

PRE-REQUISITE KNOWLEDGE

CHEE 210, (CHEE 222 or MINE 201), or permission of the department.

COURSE EVALUATION

ASSESSMENT WEIGHTING

Assessment Tool	Due Date (before 23:59 ET)	Weight	Alignment with CLOs
Midterm	~ week 6-7	25%	1,4
Design Assignment	To be specified	15%	1,2,4
Final	Exam period	60%	1,2,3,4
		100%	

ASSESSMENT DESCRIPTIONS

Midterm

Mid-term will be a CLOSED BOOK evening examination part way through the course (date to be determined). You will be tested on the fundamental concepts related to course material covered to that point (most likely Modules 1-3).

¹ Course Author(s): Michael Cunningham. 1st Edition (initial development): Fall 2021; Queen's University holds a license for the use of the Course Author's Intellectual Property for CHEE 321.

Assignments

A set of unmarked practice questions will be given for each course module, with solutions posted later.

Design Assignment

A design assignment for CHEE 321 will be provided later in the semester involve open-ended questions focusing on reactor design. Marks will be given for concise and coherent discussion, as well as technical calculations. Aspects of design will also be covered among the regular lectures and tutorials.

Students are encouraged to work together in small groups, with a maximum group size of three. One copy of the assignment will be turned in per group (not per student). Larger groups and copying of assignments will not be tolerated.

It is each student's responsibility to download and save all posted course content during the term.

Final Exam

The final exam is a 3-hour closed book examination and will cover all material covered in the class, tutorial, and assignments. Students must write their exam on the day and time scheduled by the University. You should not schedule vacations, travel, etc. during the exam period. The [Term and Session Dates](#) will indicate the final exam period session dates in each term.

GRADING

All assessments in this course will receive numerical percentage marks. The final grade you receive for the course will be derived by converting your numerical course average to a letter grade according to the established [Grade Point Index](#).

Feedback on Assessments

The teaching team will provide feedback on graded activities. You can expect feedback on your assessments within two weeks of the due date.

Accessing Your Final Grade

Your final grades will show on SOLUS. Official transcripts showing final grades will be available on the Official Grade Release Date. Please note that in official transcripts, a mark of IN (incomplete) is considered a grade, and your transcript is released with this grade.

COURSE MATERIALS

Required Textbook

H. Scott Fogler, Essentials of Chemical Reaction Engineering (2nd Edition)

Other Material

All other course material is accessible via OnQ.

Required Calculator

A Casio 991 is required. **ONLY** this type of non-programmable, non-communicating calculator will be allowed during tests and exams.

Suggested Time Commitment

Significant practice is required to solve problems efficiently and correctly in an exam setting. Students are encouraged to make use of all resources available, including the textbook and solved posted problems. Students are expected to utilize the concepts and to implement the methods taught in class to tackle a variety of problems that they may encounter in assignments/midterms/exams.

3 lecture hours + 1 tutorial hour per week. Times and locations can be found in SOLUS.

EXPECTATIONS FOR LECTURES/TUTORIALS

Lectures

Lecture slides will be posted on the course website. Some lectures will include examples and problem solutions not contained in the posted slides. Students are expected to read associated sections and study worked examples in the textbook.

Tutorials

The class is divided into two tutorial sections. Tutorial problems for the week will be posted. Please print and bring these to class. As well as working on the tutorial problem (solutions to be guided by the TAs), you will have the opportunity to ask questions related to assignment problems and lecture materials.

WEEKLY COURSE OUTCOMES

Module	Learning Outcomes	Assessment
1	<p>Reactions and the GMBE</p> <p>Lecture approach and content:</p> <ul style="list-style-type: none"> • Reaction Rates, Rate Laws and Stoichiometry • The General Mole Balance Equation (GMBE) and Ideal Reactors • Estimating Rates from Experimental Data Tutorial approach and content: <p>Worked examples, based on lecture material</p> <p>A set of practice problems is also posted (unmarked)</p>	Midterm
2	<p>Isothermal Reactors: Single Reaction in Batch, CSTR, PFR</p> <p>Lecture approach and content:</p> <ul style="list-style-type: none"> • Solving Problems using Stoichiometric Tables • Levenspiel Plots (Reactor Sizing) and Multiple Reactors • Reversible Reactions <p>Tutorial approach and content:</p> <p>Worked examples, based on lecture material</p> <p>A set of practice problems is also posted (unmarked)</p>	Midterm
Midterm	<p>Covers Modules 1 and 2</p> <p><i>2-3 worth 25% of course grade</i></p>	Midterm

Module	Learning Outcomes	Assessment
3	<p>Nonisothermal Reactor Design</p> <p>Lecture approach and content:</p> <ul style="list-style-type: none"> • Forms of the Energy Balance (EB); Isothermal and Adiabatic • CSTR with the EB; multiple steady-states • PFR with the EB <p>Tutorial approach and content:</p> <p>Worked examples, based on lecture material</p> <p>A set of practice problems is also posted (unmarked)</p>	<p>Final</p> <p>Design Assignment, 15%</p>
4	<p>Multiple Reactions</p> <p>By the end of this week, learners will be able to:</p> <ul style="list-style-type: none"> • GMBE and EB with Multiple Reactions • Selectivity and Yield <p>Tutorial approach and content:</p> <p>Worked examples, based on lecture material</p> <p>A set of practice problems is also posted (unmarked)</p>	<p>Final</p>
5	<p>Reaction Networks and Pathways</p> <p>Tutorial approach and content:</p> <p>Worked examples, based on lecture material</p> <p>A set of practice problems is also posted (unmarked)</p>	<p>Final</p>
Exam	<p>Covers all Modules</p> <p><i>Worth 60% of course grade</i></p>	<p>Final</p>

COURSE COMMUNICATION

NETIQUETTE

In this course, you may be expected to communicate with your peers and the teaching team through electronic communication. You are expected to use the utmost respect in your dealings with your colleagues or when participating in activities, discussions, and online communication.

Following is a list of netiquette guidelines. Please read them carefully and use them to guide your online communication in this course and beyond.

1. Make a personal commitment to learn about, understand, and support your peers.
2. Assume the best of others and expect the best of them.
3. Acknowledge the impact of oppression on the lives of other people and make sure your writing is respectful and inclusive.
4. Recognize and value the experiences, abilities, and knowledge each person brings.
5. Pay close attention to what your peers write before you respond. Think through and re-read your writings before you post or send them to others.
6. It's alright to disagree with ideas, but do not make personal attacks.
7. Be open to be challenged or confronted on your ideas and challenge others with the intent of facilitating growth. Do not demean or embarrass others.
8. Encourage others to develop and share their ideas.

QUESTIONS ABOUT COURSE MATERIAL

Questions or comments regarding the course material that can be of benefit to other students should be posted in the Q&A forum on the class website. The instructor, TAs, and students are encouraged to answer these questions directly in the discussion forum for the benefit of everyone in the course.

COURSE ANNOUNCEMENTS

The instructor will routinely post course news in the Announcements section on the main course homepage on OnQ. Please sign up to be automatically notified by email when the instructor posts new information in the Announcements section. Instructions on how to modify your notifications are found in the **Begin Here** section of the onQ course site.

OFFICE HOURS

In addition to interaction in the Q&A discussion forums, you will have the opportunity to interact with either a TA or the instructor through office hours. The instructor will provide a schedule of availability at the beginning of the term.

CONFIDENTIAL MATTERS

If you have a confidential matter you would like to discuss with your instructor, their contact details are on the first page of this document. Expect email replies within 48 hours.

STANDARD FEAS INFORMATION

COURSE POLICIES

Please review the following policies concerning copyright, academic integrity, absences and academic accommodations:

COPYRIGHT

Course materials created by the course instructor, including all slides, presentations, synchronous and asynchronous course recordings, handouts, tests, exams, and other similar course materials, are the intellectual property of the instructor. It is a departure from academic integrity to distribute, publicly post, sell or otherwise disseminate an instructor's course materials or to provide an instructor's course materials to anyone else for distribution, posting, sale or other means of dissemination, without the instructor's **express consent**. A student who engages in such conduct may be subject to penalty for a departure from academic integrity and may also face adverse legal consequences for infringement of intellectual property rights and, with respect to recordings, potentially privacy violations of other students.

ACADEMIC INTEGRITY

As an engineering student, you have made a decision to join us in the profession of engineering, a long-respected profession with high standards of behaviour. As future engineers, we expect you to behave with integrity at all times. Please note that Engineers have a duty to:

- Act at all times with devotion to the high ideals of personal honour and professional integrity.
- Give proper credit for engineering work

The standard of behaviour expected of professional engineers is explained in the [Professional Engineers Ontario Code of Ethics](#). Information on policies concerning academic integrity is available in the [Queen's University Code of Conduct](#), in the [Senate Academic Integrity Policy Statement](#), on the [Faculty of Engineering and Applied Science website](#), and from your instructor.

Departures from academic integrity include plagiarism, use of unauthorized materials or services, facilitation, forgery, falsification, unauthorized use of intellectual property, and collaboration, and are antithetical to the development of an academic community at Queen's. Given the seriousness of these matters, actions which contravene the regulation on academic integrity carry sanctions that can range from a warning or the loss of grades on an assignment to the failure of a course to a requirement to withdraw from the University.

In the case of online or remotely proctored exams, impersonating another student, copying from another student, making information available to another student about the exam questions or possible answers, posting materials to online services, communicating with another person during an exam or about an exam during the exam window, or accessing unauthorized materials, including internet sources and using unauthorized materials, including smart devices, are actions in contravention of academic integrity.

LATE POLICY

Any applicable late penalties are described in the details for each assessment. In the event of extenuating circumstances, you must follow the policies for requesting an academic consideration (please see below). Note that unacceptable reasons include extra-curricular activities, travel plans, generally behind on schoolwork, etc. In the absence of an approved consideration request, the normal late penalty will apply as described in the assignment or any course/departmental policies.

INVALID EXAMS

An exam may be declared invalid in case of an interruption in an in-person examination; if the instructions in a remote or online exam were not followed; if the student uploads wrong materials; or if a situation arises where the integrity of the exam cannot be verified. If an exam is declared invalid, the student may be granted a re-write.

ABSENCES (ACADEMIC CONSIDERATIONS) AND ACADEMIC ACCOMMODATIONS

For absences and academic accommodations please review the information on the [FEAS website](#).

ACADEMIC AND STUDENT SUPPORT

Queen's has a robust set of supports available to you including the [Library](#), [Student Academic Success Services \(Learning Strategies and Writing Centre\)](#), and [Career Services](#). Learners are encouraged to visit the Faculty of Engineering and Applied Science [Current Students](#) web portal for information about various other policies such as academic advisors, registration, student exchanges, awards and scholarships, etc.

INDIVIDUAL NEEDS AND SUPPORT

If you have a disability or health-related condition that may require academic accommodations, please approach the [Queen's Accessibility Services](#). The staff at Accessibility Services are available by appointment to develop individualized accommodation plans, provide referrals, and assist with advocacy. The sooner you let us know your needs, the better we can assist you in achieving your learning goals. For questions or assistance with requesting Academic Consideration or Accommodation, contact the FEAS Academic Accommodation Coordinator at engineering.aac@queensu.ca

Every effort has been made to provide course materials that are accessible. For further information on accessibility compliance of the educational technologies used in this course, please consult the links below.

EDUCATIONAL TECHNOLOGY	ACCESSIBILITY COMPLIANCE INFORMATION
onQ (Brightspace Learning Management System by D2L)	https://www.d2l.com/accessibility/standards/
MS-Teams	https://support.microsoft.com/en-us/office/accessibility-support-for-microsoft-teams-d12ee53f-d15f-445e-be8d-f0ba2c5ee68f
Zoom	https://zoom.us/accessibility

If you find any element of this course difficult to access, please discuss with your instructor how you can obtain an accommodation.

RELIGIOUS OBSERVANCE

Students in need of accommodation for religious observance are asked to speak to their professor within a week of receiving their syllabus. Note also that alternative assignments are considered a "reasonable accommodation" under the Ontario Human Rights Code. Students with questions about their rights and responsibilities regarding religious accommodation should contact the Chaplain via Chaplain@queensu.ca.

TECHNICAL SUPPORT

Some basic comfort level with basic hardware and software skills are required for this course. If you require technical assistance, please contact [Technical Support](#).

SUPPORTIVE PERSONAL COUNSELLING

If at any time you find yourself feeling overwhelmed, anxious, sad, lonely, or distressed, consider confidential supportive counselling offered by the [embedded counselors](#) at the Student Wellness Service Faculty of Engineering and Applied Science.