

Chemical Engineering 4N4, Fall 2013

Engineering Economics and Problem Solving

Instructor

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Teaching assistants

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Their office hours are by appointment only; please email TAs to check.

Class time and location

- *Class*: PC (Psychology complex), room PC 155, on Tuesday, Wednesday and Friday morning, 09:30 to 10:20
- *Tutorial group A*: JHE 342, Monday, 11:30 to 13:20
- *Tutorial group B*: JHE 342, Monday, 14:30 to 16:20

Disclaimer

The instructor reserves the right to modify elements of the course during the term. If either dates or deadlines must be modified, reasonable notice and communication with students will be given, with explanation, and the opportunity to comment on changes. It is the responsibility of the student to check the website **daily** during the term and to note any changes.

1 About the course

Please read carefully

The 4N4 course is quite different to other Chemical Engineering courses you've taken so far.

Official description

Making decisions about the design and operation of engineering systems with the analysis emphasizing safety, economics, equipment performance, uncertainty, flexibility and monitoring, including troubleshooting. Students will work individually and in groups on problem-based projects.

Prerequisites

CHEM ENG 204 (or 304), 3K4, 3M4, 3P4, and 3G4.

Course objectives, i.e. "What you must be able to demonstrate by the end of the course"

Given a strong foundation in the fundamentals of Chemistry, Physics, Mathematics, and Engineering Science, you will learn to apply these – together with safety, ethical, environmental and financial criteria – to solve practical, industrial problems. The emphasis is on gaining confidence in applying what you know. This course gives you an opportunity to consolidate and apply skills learned in the extensive list of course prerequisites. The course is about 50% "chemical engineering" and about 50% "problem solving and process skills". The course integrates technical skills and professional skills that you will apply for the rest of your career, whether you remain a chemical engineer or not.

Let's take a look at the McMaster calendar for the Faculty of Engineering. They describe: "*Engineering is a profession concerned with the creation of new and improved systems, processes and products to serve human needs. The central focus of engineering is design, an art entailing the exercise of ingenuity, imagination, knowledge, skill, discipline and judgment based on experience. The practice of professional engineering requires a mastery of engineering methodology together with a sensitivity to the physical*

properties of materials, to the logic of mathematics, to the constraints of human, physical and financial resources, to the minimization of risk, and to the protection of the public and the environment.”

McMaster’s chemical engineering graduates, those that complete 4N4 achieve these goals:

- aim to become professional engineers that invest in life-long learning
- know how to use research resources effectively (libraries, internet resources, and reference books)
- can learn on their own (self-directly learning, SDL): define your goal, investigate the topic and test/refine your learning
- understand basic approaches for providing safety in process design and operation and realize that process safety is of paramount importance
- understand engineering ethics
- can evaluate the financial attractiveness of alternative engineering decisions
- are able to thoroughly review a complex process system (via its process and instrumentation diagram) for all major categories of operability
- recognize that process equipment does not operate exactly as designed, and will experience faults
- know how to go about systematically troubleshooting a process by creating a hypothesis, performing experiments, and drawing valid conclusions
- work effectively in group projects, especially building chairperson skills and preparing agendas
- can clearly communicate by letter, formal report and email
- are able to apply a systematic problem solving approach and cope with ambiguity and uncertainty
- are skilled in time management for managing projects
- understand economic principles as applied to engineering projects, but also your personal finances

Rationale

What does this course do to contribute to the overall program objectives? Most of the engineering fundamentals you will have mastered in your previous courses. The purpose of this course is to integrate those fundamentals, illustrate how you apply them and introduce you to a variety of criteria you use in applying the fundamentals. These criteria include ethics, safety, environmental, operability, economical and technical feasibility.

We will be building on your previously developed skills from other courses and integrating them **when you work in groups** on your project.

In addition, we use small group problem-based learning to develop your skill and confidence in lifetime learning skills. Since this is the only formal place where we do this, we trust that you gain the most from this experience. We develop your skills in creating hypotheses, performing “imaginary” experiments, and drawing valid conclusions in the troubleshooting.

Course materials and website

The course website will be permanently available at: <http://learnche.mcmaster.ca/4N4>. Course materials, assignments and solutions, project postings *etc* will be available from the website.

Course announcements will only be posted to the main page of the website – students are expected to check the website at least once per day. Please note that this is **not an Avenue course website**; the use of Avenue will only be for your grades. The instructor and TAs will not be using the Avenue message boards and other Avenue tools during this course.

Textbooks, other reference material and resources

There is no official course textbook. We will be using the departmental material based on notes from previous instructors: Don Woods and Thomas Marlin. These notes will only be available for download from McMaster computers. Please respect the copyright requested by the authors notes and do not share with others outside your class.

Recommended textbooks are listed on the course website. All are available in Thode Library or via McMaster electronic subscriptions. We will consider many different topics. Some will be in depth; others very briefly. You will have to use your judgement as an engineering professional on whether you want to purchase these materials to use during your future career.

For this course, the library, professional societies, internet, industrial suppliers, and so forth are your textbook. Please reference your sources accordingly in assignments and projects. You will need to use these resources for answering open-ended problems; this will help you enhance your research and inquiry skills. The instructor will provide additional reference links on the course website under each topic.

Finally note: there are many more resources than you have time to read. Part of self-directed learning is building the skill to sort through a vast quantity of available data to find the information you need.

2 Format

The roles of the instructor and students are modified in this course to help you in the transition from university student to professional engineer.

The principle used in this course is that you are working in a company, let's call it McChem Inc. There will be challenging assignments set by your manager (Kevin) and colleagues (Danielle and Chris). These could easily consume all of your time. Your manager and his colleagues may seem to ask for more complicated answers than are humanly possible in the time available. Part of the learning experience in this course is for you to scope the problem and provide a solution given the available time. Scoping the problem requires using your group's judgement, consulting with your manager (he is busy though), so you should first try his two colleagues. Based on this, your group will set goals, develop a feasible plan, and complete the tasks within the allotted time.

Group work

Much of the term work will be performed in groups of 5 each, which will be arranged in the first week of the semester. Students must choose groups so **all group members attend the same tutorial slot**. The instructor and TAs will be involved with the process group allocation.

This experience will help you build your group skills, both as leader and supporter. If possible, the group should resolve conflicts based on established group norms. Important conflicts that cannot be resolved by the students should be discussed with your manager.

Group submissions will have the names of all group members who participated. If any member was absent (or did not participate), this must be noted on the assignment. Do not submit the names of people who have not contributed: this is also academic dishonesty.

Attendance

While with other courses it is quite acceptable to not attend classes, with this course, not attending classes, tutorials, and other events where group work is required would be equivalent of not showing up at work, and leaving your colleagues to carry your load.

This semester is very busy because you will likely be participating in employment interviews and company visits. This complicates course grading and impacts your group work. Follow this procedure please:

1. Gain the agreement of the members of your group that you can miss a course activity.
2. Submit a written explanation to the course instructor before the absence. Details regarding your absence must be provided. The instructor will reply in writing.

Note: this procedure does not replace the standard approach of contacting the Associate Dean of Engineering for medical or family reasons; these MSAFs will be dealt with, as needed, by the instructor. However, no one will be excused from the SDL Project or final exam.

Feedback

Completely anonymous feedback, comments, criticism, questions about the course material, and advice on how to improve the course can always be submitted at <http://learnche.mcmaster.ca/feedback-questions>. Thank you. The earlier you submit this feedback, the sooner we can improve the course for the whole class.

3 Grading

The grading for this course is tailored to the importance of the task. In this course, most evaluation will be based on the products of your assignments and tutorials. There will be intermediate tests. The course will have a final examination.

- We require you to complete all group tasks in your self-selected groups. There are no exceptions to this rule: *individual hand-ins will not be graded*. Assemble a **single submission** for the group - the TAs will not grade loose sheets handed in after the first submission. All group submissions must clearly show the names and student numbers of the group members that actually contributed to the work. Do not add a name of a group member that did not contribute.
- Grades for the work will be determined based on the group's result and the student's individual contribution. The grade will be then be modified based on peer evaluation. Since the instructor is not able to observe your individual contribution to the group, we will employ a method similar to that developed by Dr. Felder of the famous "Felder and Rousseau" textbook (Kaufman, Felder, and Fuller, *Journal of Engineering Education*, April 2000, 133-140), described below.

Every student must provide a confidential peer evaluation of all other members in his/her group. This evaluation will be completed electronically. Each student will have his/her grade modified by the following formula for the project.

$$\text{Student grade} = \text{Group grade} \times \sqrt{\frac{\text{Student individual average score}}{\text{Group average score}}}$$

The modifier factor under the square root is 1.0 for middle-of-the road performance, but can be higher or lower than this, depending on peer-assessment.

- The graded tutorials and workshops provide (a) feedback to students and (b) performance measures for grading. These graded exercises do not require extensive preparation; just keep up with the material.
- All term work is due at the beginning of the class, unless otherwise specified. All material submitted must include a cover memorandum as defined in the course. The total grade for any task may be based entirely on the cover letter, at the discretion of the instructor. Substantial grades will be deducted for not following instructions *completely*; for example -20% for not including a cover letter on an item of work. The deduction is at the discretion of the TA and instructor.
- Wherever possible, the submissions are evaluated in terms of what would be expected in engineering practice. This applies to the format and clarity used in presenting your results, and to the practicality and reasonableness of your answer.
- The term work will depend to some extent on decisions during the semester; however, the course will not deviate greatly from the point distributions for the key graded tasks during the term, as outlined in the following table.

Task	Maximum grade
Group-submitted assignment/tutorial answers	25%
Group project (graded meeting, interim and final reports)	28%
Midterm test	10%
Final exam	25%
Online questions, reflections and peer feedback	12%
TOTAL	100%

- You, and your group, will receive the greatest benefit if you plan a strategy for the task where you **all** participate in *all* questions. A deeper understanding will come from reviewing each other's work – in the same way that an engineer's work is always reviewed by their colleagues in companies around the world.

Arrange to meet outside of class and review the work, discuss alternative approaches, and craft a single submission.

You are defeating the purpose of the group-based assignment if you simply divide the task into sections and cut-and-paste a single submission without discussion. You also run the risk of loosing marks due to any

inaccuracies in your colleagues' work. But most importantly you lose out on the learning opportunity of seeing your mistakes and group member's mistakes, and learning from them. You also will not develop group collaboration skills, which are critical to succeed in any work environment.

Innovative and free tools such as camera-based calling (Skype, FaceTime, *etc*) and free collaborative document editing tools ([Google Docs](#), [Zoho](#), [Microsoft SkyDrive](#), *etc*) allow within-group teamwork for occasions when your team cannot meet in person. Please make the most of these technologies.

- No sharing of any work may be done between groups. This includes handwritten documents and electronic files of any type. This will be strictly enforced. Please ensure that you have read the University's academic integrity policy (part of which is reproduced below).
- This is a large class of about 90 students, so late hand-ins interfere with the ability to efficiently grade your assignments. Late assignments will be penalized by deducting 30% per day for every late day. A grade of zero will be given for submissions handed in after the solutions are posted (usually within 2 days of assignment hand-in).
- No make-ups will be given for any part of the course (midterm, assignments and tutorials).
- Each student will write the final exam individually. Any paper-based materials (textbooks, notes, *etc*) are allowed during tests and exams. Any calculator may be used during the tests and exams.
- The final percentage grades will be converted to letter grades using the Registrar's recommended procedure. Adjustment to the final grades may be done at the discretion of the instructor.
- The final exam will be cumulative, based on the entire semester's material.

4 Important notes

Classroom resources

A cell phone, laptop, tablet computer, or some sort of device to connect to the internet in the class rooms, while not mandatory, will definitely help, especially for tutorials. The tutorial venue has some electrical outlets for laptops.

Course software

No specific software is required, however programs such as MATLAB, Python, Excel, or whatever software best suits your needs, may be used to answer questions.

The course project **must** be submitted electronically, preferably using Google Docs. Grading will be done electronically in the document to minimize the use of paper reports. Groups should aim to start their report in Google Docs and complete it there. Importing existing documents, e.g. from Microsoft Word, is not always robust. If your group prefers not to use Google Docs, submitting as a PDF is acceptable, but ZIP files of documents, and native Word documents **are not acceptable**.

Out-of-class access and email

The TAs and instructor for this course can be contacted by email to arrange a face-to-face meeting - please see their email addresses above. Try to send email from your McMaster account - email from personal accounts are sometimes discarded by spam filters. Your instructor filters his email, so emails from @mcmaster.ca addresses receive priority.

5 Academic integrity

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity.

Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences, e.g. the grade of zero on an assignment, loss

of credit with a notation on the transcript (notation reads: “Grade of F assigned for academic dishonesty”), and/or suspension or expulsion from the university.

It is your responsibility to understand what constitutes academic dishonesty. For information on the various types of academic dishonesty please refer to the Academic Integrity Policy, located at <http://www.mcmaster.ca/academicintegrity>

The following illustrates only three forms of academic dishonesty:

1. Plagiarism, e.g. the submission of work that is not one’s own or for which other credit has been obtained.
2. Improper collaboration in group work: this point is particularly important and will be strongly penalized in this course.
3. Copying or using unauthorized aids in tests and examinations.

Consider this course outline to be a first warning; any lack of academic integrity will not be accepted.

6 Accessibility

The instructor aims to make this class accessible to all students. Please forward and optionally discuss any accommodation granted by [Student Accessibility Services \(SAS\)](#) with the instructor *before the third week of the course*. Please raise any other accessibility issues with the instructor as soon as possible, e.g. accessibility of the course website and course materials.

7 Important dates

A list of *tentative* dates is given below. Not all assignment due dates are known yet.

Date	Event
06 September	First class: course overview
07 September	Group selections due
13 September	Economics assignment due
20 September	Economics assignment due
27 September	Economics assignment due
04 October	Assignment due
11 October	Assignment due
16 October	Midterm
25 October	Assignment due
11 November	Graded team meetings
18 November	Graded team meetings
04 December	SDL report due at 16:30
06 to 20 December	Final exams