Chemical Engineering 4N4, Fall 2012
Engineering Economics and Problem Solving

Instructor

Kevin Dunn, kevin.dunn@mcmaster.ca (BSB, room B105)

Teaching assistants

Alicia Pascall pascalaa@mcmaster.ca (JHE 370, ext 22008)

Yasser Ghobara ghobary@mcmaster.ca (JHE 369, ext 24031)

Office hours are by appointment only.

Class time and location

- Class: DSB (business school), room AB102, on Tuesday, Thursday and Friday morning, 11:30 to 12:20
- Tutorial group A: JHE 342, Monday, 09:30 to 11:20
- 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 `2O4` (or `3O4`), `3K4`, `3M4`, `3P3` (or `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, where you remain a chemical engineering or not.

McMaster's chemical engineering graduates:

- are professional engineers that invest in life-long learning
- are technically sophisticated with an emphasis on the fundamentals

- 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 experiences faults
- know how to go about systematically troubleshooting a process by creating a hypothesis, performing experiments, and drawing valid conclusions
- know how to use research resources effectively (libraries, internet and reference books)
- 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
- can learn on their own (self-directly learning, SDL): define your goal, investigate the topic and test/refine your learning
- 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, grades, *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 be minimal or non-existent for this course. 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 Don Woods and Thomas Marlin's notes and do not share with others outside your class.

Recommended textbooks are listed on the course website. All are available in Thode Library; the most highly recommended books are on 24-hour reserve. 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 provided additional reference links on the course website under each topic.

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 (Alicia and Yasser). 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.

Note that some classes have specified tasks that can be performed during class time or any other time (before the next class) by the students. Naturally, the task must be performed before the learning goals are needed for a subsequent task or tutorial/workshop. The instructor and TA will usually be available during class time for consulting on the task.

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. Both individual and team assignments are used in the course. For some topics you will be learning on your own, but most will be small group, problem-based learning.

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 team mates to carry your load. To encourage class participation there will be graded tasks and the odd unannounced quizzes throughout the semester.

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 on exactly when and where you will be 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 more than 40 points in total (see grading section).

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, and some unannounced class quizzes. 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: no individual hand-ins will 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.
- For major projects (e.g the self-directed learning project), the grade will be determined based on the group's result and the student's individual contribution, as measured by instructor evaluations. The grade will be then modified based on peer evaluation. The instructor may join a group at any time to observe the effectiveness of the chairperson and group interactions.
- 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; material submitted during or at the end of class will have points deducted for being late. 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.

Term Task	**Maximum points**
Group learning projects and personal finance tutorial	10
Economic feedback on time value of money	15
Graded sensitivity analysis	15
Process drawings	10
Economics workshop on profitability and comparisons (graded tutorial)	40
Economics assignment on cost estimating and profitability	30
Safety (graded tutorial)	20
Interim report on SDL/process project	20
SDL/Process - Technical report	70
SDL/Process - Presentation and class notes	30
Group reflections - chairperson and group dynamics report	20
Course reflection - overview of the course, what you learned, how you learned	20
TOTAL	**300**

The final grade will be allocated from 65% term work, 10% midterm and 25% final exam, i.e.

$$\text{Student's grade} = 0.65(\text{Student's term work}) + 0.35(\text{Student's exams})$$

$$\text{Student's term work} = \frac{\sum \text{Student's term points from the above table}}{\text{Student's maximum term points}}$$

$$\text{Student's maximum term points} = 300 - \text{points from } \textit{excused} \text{ absences}$$

- 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, typewith.me, 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, other than the final exam, this includes any mid-term tests.
- 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

Please bring a calculator to every class. 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 for tutorials and answering questions during class. The class and tutorial venues have 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 using the Google Docs app that is now part of the McMaster student email system. Grading will be done electronically in the document to minimize the use of paper reports. Google Docs allows you to import text from a wide variety of formats (e.g Microsoft Word), so you can start your project elsewhere and upload it for final editing and submission via Google Docs.

Out-of-class access and email

Office hours will be arranged during the first 2 weeks of the course and posted on the course website and the instructor's website, http://learnche.mcmaster.ca.

The TAs for this course can be contacted by email - 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 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:

Date	**Event**
03 September	First class: course overview
10 September	Engineering economics; group selection and group norms discussion
17 September	Engineering economics: time-value of money, profitability comparisons
24 September	Economics: depreciation; project decisions
01 October	Group learning project presentations; economics: cost estimation
08 October	Economics: cost estimation
15 October	Safety workshops and lectures
22 October	Safety tutorial; Troubleshooting exercises
29 October	Troubleshooting; SDL: intermediate project oral reports
05 November	Process operability and flexibility
12 November	Troubleshooting workshop; dynamic process performance and efficiency
19 November	Student SDL project reports and presentations
26 November	Student SDL project reports and presentations
03 December	SDL report due at 16:30
05 to 19 December	Final exams