

CHEMENG 3I03
Data Acquisition and Analysis
Fall 2020 Course Outline

Calendar/Course Description

This course acquaints students with the principles of data acquisition and analysis as it pertains to engineering applications. Topics will cover important aspects related to statistics, sampling, error analysis, calibration, and data interpretation, as well as familiarize the student with the measuring technologies typically used in Chemical Engineering. Understanding the relevance of measurements collected from different types of physical sensors will be developed through lectures covering operating principles and reinforced through lab experiments.

Pre-Requisites and Anti-Requisites

Prerequisite(s): Registration in Level III or above of any Chemical Engineering program

Antirequisite(s): CHEMENG 2I03

Instructor Office Hours and Contact Information

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Office Hours:

By Appointment

Teaching Assistants and Contact Information

Kristen Hayward

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Class time and location: Mon 15:30-17:20 (MS Teams)

Lab times and location:

- L01 Tues 14:30-17:20 (MS Teams)
- L02 Wed 8:30-11:20 (MS Teams)
- L03 Fri 13:30-16:20 (MS Teams)
- L04 Mon 8:30-11:20 (MS Teams)
- L05 Wed 14:30-17:20 (MS Teams)

Course Objectives

By the end of this course, students should be able to:

- Design appropriate experiments based on previous experimental results or theory
- Use statistics to properly analyze and present data
- Select appropriate sensors for engineering applications and justify the selection
- Properly place sensors for appropriate sampling
- Properly calibrate sensors and demonstrate understanding of different calibration requirements
- Demonstrate understanding of the theory behind sensor operation
- Predict experimental results, based on theory, leading to appropriate experimental design and proper use of statistics to present data
- Properly record data using principles of data acquisition

Course Materials

Suggested Text:

R.S. Figliola, D. E. Beasley. Theory and Design for Mechanical Measurements. 6th ed., Wiley and Sons, NY, 2014 (4th ed. 2003 and 5th ed. 2010 are acceptable too)

Other Materials:

Course material posted on Avenue

Lab coats and goggles are required for laboratory.

Course Overview

| Week/Date | Topic | Labs | Due |
|-------------|------------------------------------|-----------------------|--------------------------|
| 1. Sept. 7 | Monday Holiday (no lecture/labs) | No Lab | |
| 2. Sept. 14 | Introduction/Statistics | No Lab | |
| 3. Sept. 21 | Statistics | Excel Lab 1 | Assignment 1 |
| 4. Sept. 28 | Statistics | Excel Lab 2 | Excel Lab 1 |
| 5. Oct. 5 | Uncertainty | Excel Lab 3 | Excel Lab 2 |
| 6. Oct. 12 | Sampling and Calibration | No Lab | Excel Lab 3/Assignment 2 |
| 7. Oct. 19 | Reading Week | | |
| 8. Oct. 26 | Temperature Sensors | Temperature Lab Day 1 | Statistics Project |
| 9. Nov. 2 | Temperature/Pressure Sensors | Temperature Lab Day 2 | Assignment 3 |
| 10. Nov. 9 | Pressure Sensors | Temperature Lab Day 3 | |
| 11. Nov. 16 | Flow Sensors | pH Lab Day 1 | Temperature Lab Report |
| 12. Nov. 23 | Chemical Sensors | pH Lab Day 2 | Case Study 1 |
| 13. Nov. 30 | Mechatronic Sensors | pH Lab Day 3 | |
| 14. Dec. 7 | Piping and Instrumentation Diagram | No Lab | pH Lab Report |

| Assessment Component | Weight |
|-------------------------------|--------|
| Assignments (3) | 6% |
| Excel Labs (3) | 15% |
| Progress Logs (4) | 4% |
| Lab Report 1 (Temperature) | 15% |
| Lab Report 2 (pH) | 15% |
| Statistics Project | 20% |
| Case Study 1 | 5% |
| Case Study 2 (Take home exam) | 20% |
| Total | 100% |

Notes:

- The instructor reserves the right to alter the evaluation scheme if necessary.
- Grading will be determined from the instructor's gradesheet not marks listed on Avenue. In the case of discrepancies between the two, the marks on Avenue will be disregarded.

Course Grading

The overall percentage for the course will be converted to a letter grade using the scale recommended by the Office of the Registrar. The instructor reserves the right to adjust marks up or down. Graded reports will be kept in the department for a minimum of one year, in accordance with Senate regulations.

Methods of Communication

Announcements, labs, case studies, and lecture slides will be posted on Avenue to Learn (<http://avenue.mcmaster.ca/>). All assignments will be submitted and graded on Avenue to Learn. The most up-to-date course outline will be posted on Avenue.

Lectures and labs will be held on MS Teams at the scheduled times. Recording of the lectures and labs will be posted on MS Stream. The instructor and the teaching assistants will primarily communicate with students via their McMaster email address. If there are any questions, please email the instructor or the teaching assistants at the email addresses provided above.

Working in Groups – Submission of Shared Work

The instructor of this course fully supports the importance of engineering students learning to work in groups. But there are often problems with everyone contributing equally as the group grows large in size. As a result, for the **case study 1 report**, **groups of two** students may work and submit the case study reports together. For the **temperature lab**, **groups of three** may submit their report together.

In such cases of working together, it is important that proper acknowledgement be given. A form, the Group Declaration page, must be downloaded from Avenue and attached to the front of a submission with the signature of all persons shown. No grade will be given if there is no signature. Signatures cannot be added after the submission is graded.

Missed Work

Any missed work in this course (presentation, assignment or lab) will be exempt upon receiving a McMaster Student Absence Form (MSAF). A lab period may be rescheduled if missed provided there is sufficient time to do so. The grade value of all missed work will be added to the value of other assessments determined the instructor.

A MSAF *must be received within a span of two-weeks or before the examination ban, whichever is shortest.* **No MSAF will be accepted once the lectures have ended for the course.** Students are reminded that it is the policy of the Engineering faculty that students are responsible to follow up with the instructor directly once filing an MSAF, and ensure it was received. This is important since often students may enter the wrong email address for the instructor and the MSAF will never be received. It is not the responsibility of the instructor to follow up on such matters.

Lecture Time

One 110 minutes lectures per week. Lectures will be conducted live at the scheduled time on MS Teams. In order to accommodate students that may not be able to attend lectures, the lectures will be recorded and posted on MS Stream. Topics covered will include: the technical aspects of statistics, data collection, data analysis, sensor operation and measurement/sampling error.

Avenue to Learn

This course uses the university's learning management system, Avenue to Learn, to allow communication between the students and to provide access to grades. Marks posted on Avenue are given for information purposes only – the final grade of the course is determined from the instructor's gradesheet. It is important that students understand how the system is used by the teaching staff to avoid problems throughout the course.

The instructor (and possibly the TAs) will use this medium to communicate announcements and provide grades whenever the assignments/labs etc. are marked. Neither the e-mail nor discussion board features on Avenue are monitored by the teaching staff. The discussion board is intended for students to collaborate on their reports. Report any misuse of the board to the instructor.

Reports/assignments are due in the Avenue dropboxes. All files (except relevant Excel files) must be in LEGIBLE pdf format.

MS Teams

Due to the COVID-19 pandemic, this course will be offered as a virtual course in Fall 2020. All lectures and labs will be conducted in MS Teams. Lectures will be held at the scheduled time in the Lecture channel. All lectures will be recorded on posted on MS Stream. Labs will be conducted in the Lab channel at the scheduled times. TAs will be available to answer questions about the labs during the lab time. Although attendance is not mandatory, students are encouraged to make use of the lab time by seeking help from the TAs. MS Teams will also be used for office hours. Students can book office hours with the instructor or the TAs and the meetings will be held on MS Team. Lastly, students can use MS Teams to communicate with other students for group work. Any comments or behavior deemed inappropriate on the CHEMENG 3I03 Team will be flagged.

Assignments

There are three assignments for this course. They primarily give students experience with the few calculations required in this course. Assignments are to be handed in on their due date as a PDF file in the appropriate Avenue dropbox. The assignment can be downloaded from Avenue along with data files (if required) and in some cases, examples. An assignment may be one day late and be accepted with a penalty of 10%. No work will be accepted following that extra day (see Missed Work policy above). The assignments will be marked out of 2. If the assignment is complete and mostly correct, the assignment will be given a grade of 2/2. If the assignment is incomplete or complete but with major errors then the assignment will give a grade of 1/2.

Examination

There will be no midterm or final exam for CHEMENG 3I03 this year.

Laboratory

Each student will take part in five labs: 3 excel labs and 2 experimental labs. For the 3 excel labs, the lab manual and the datasets will be provided on Avenue. The excel labs are due one week after the lab is assigned. The lab reports are to be submitted on Avenue.

There are two experimental labs: Temperature sensor lab and pH sensor lab. There are three sessions (weeks) for each experimental lab. Data will be collected on the first two sessions and the last sessions students can explore the experimental setup further or gather more data to supplement the data from the first two sessions. After each of the first two sessions, a progress log must be submitted one day after the scheduled lab time. The final lab report is due one week after the third session. All progress reports and lab reports are to be submitted on Avenue. Failure to hand in the report on time will result in a penalty of 20% per day late, with first day late starting after 11:59 pm the day it was due. The temperature sensor lab report can be completed in a group of 3. The pH sensor lab report must be completed individually. Please refer to the lab manual and the lab report writing guidelines for details regarding the requirements for the lab reports.

The course is offered as a virtual course this year, therefore no in-person labs will be conducted. Videos of the lab procedures will be provided along with previously collected data. Students are required to use the data provided to complete the progress logs and lab reports. The purpose of the labs is to gain practical experience with Excel, data collection, sampling, calibration and use of sensors.

Accreditation Learning Outcomes

The Learning Outcomes defined in this section are measured for Accreditation purposes only, and will not be directly taken into consideration in determining a student's actual grade in the course.

Learning Outcomes

Indicators

| | |
|--------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| Design appropriate experiments based on previous experimental results or predicted results from theory | 3.3 Estimates outcomes, uncertainties and determines appropriate data to collect. |
| Select appropriate sensors for engineering applications and justify the selection | 5.1 Evaluates and selects appropriate modern tools. |

For more information on Accreditation, please visit: <https://www.engineerscanada.ca>

Conduct Expectations

As a McMaster student, you have the right to experience, and the responsibility to demonstrate, respectful and dignified interactions within all of our living, learning and working communities. These expectations are described in the [Code of Student Rights & Responsibilities](#) (the “Code”). All students share the responsibility of maintaining a positive environment for the academic and personal growth of all McMaster community members, **whether in person or online.**

It is essential that students be mindful of their interactions online, as the Code remains in effect in virtual learning environments. The Code applies to any interactions that adversely affect, disrupt, or interfere with reasonable participation in University activities. Student disruptions or behaviours that interfere with university functions on online platforms (e.g. use of Avenue 2 Learn or MS Teams for delivery), will be taken very seriously and will be investigated. Outcomes may include restriction or removal of the involved students’ access to these platforms.

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. **It is your responsibility to understand what constitutes academic dishonesty.**

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. For information on the various types of academic dishonesty please refer to the [Academic Integrity Policy](#), located at <https://secretariat.mcmaster.ca/university-policies-procedures-guidelines/>

The following illustrates only three forms of academic dishonesty:

- plagiarism, e.g. the submission of work that is not one’s own or for which other credit has been obtained.
- improper collaboration in group work.
- copying or using unauthorized aids in tests and examinations.

Authenticity/Plagiarism Detection

Some courses may use a web-based service (Turnitin.com) to reveal authenticity and ownership of student submitted work. For courses using such software, students will be expected to submit their work electronically either directly to Turnitin.com or via an online learning platform (e.g. A2L, etc.) using plagiarism detection (a service supported by Turnitin.com) so it can be checked for academic dishonesty.

Students who do not wish their work to be submitted through the plagiarism detection software must inform the Instructor before the assignment is due. No penalty will be assigned to a student who does not submit work to the plagiarism detection software. **All submitted work is subject to normal verification that standards of academic integrity have been upheld** (e.g., on-line search, other software, etc.). For more details about McMaster’s use of Turnitin.com please go to www.mcmaster.ca/academicintegrity.

Academic Accommodation of Students with Disabilities

Students with disabilities who require academic accommodation must contact [Student Accessibility Services](#) (SAS) at 905-525-9140 ext. 28652 or sas@mcmaster.ca to make arrangements with a Program Coordinator. For further information, consult McMaster University's [Academic Accommodation of Students with Disabilities](#) policy.

Academic Accommodation for Religious, Indigenous or Spiritual Observances (RISO)

Students requiring academic accommodation based on religious, indigenous or spiritual observances should follow the procedures set out in the [RISO](#) policy. Students should submit their request to their Faculty Office **normally within 10 working days** of the beginning of term in which they anticipate a need for accommodation or to the Registrar's Office prior to their examinations. Students should also contact their instructors as soon as possible to make alternative arrangements for classes, assignments, and tests.

Academic Accommodations for Relief for Missed Academic Term Work

Students requiring academic accommodation based on religious, indigenous or spiritual observances should follow the procedures set out in the [RISO](#) policy. Students should submit their request to their Faculty Office **normally within 10 working days** of the beginning of term in which they anticipate a need for accommodation or to the Registrar's Office prior to their examinations. Students should also contact their instructors as soon as possible to make alternative arrangements for classes, assignments, and tests.

Inclusive Environment Statement

We consider this classroom to be a place where you will be treated with respect, and we welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, ability – and other visible and non-visible differences. All members of this class are expected to contribute to a respectful, welcoming and inclusive environment for every other member of the class. We will gladly honour your request to address you by an alternate name or gender pronoun. Please advise us of this preference early in the term.

Courses with an Online Element

This course will use online elements (e.g. e-mail, Avenue to Learn (A2L), MA Teams, web pages, capa, Moodle, ThinkingCap, etc.). Students should be aware that, when they access the electronic components of a course using these elements, private information such as first and last names, user names for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in a course that uses online elements will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure please discuss this with the course instructor.

Online Proctoring

Some courses may use online proctoring software for tests and exams. This software may require students to turn on their video camera, present identification, monitor and record their computer activities, and/or lock/restrict their browser or other applications/software during tests or exams. This software may be required to be installed before the test/exam begins.

Requests for Relief for Missed Academic Term Work

McMaster Student Absence Form (MSAF): In the event of an absence for medical or other reasons, students should review and follow the Academic Regulation in the Undergraduate Calendar "Requests for Relief for Missed Academic Term Work".

Copyright and Recording

Students are advised that lectures, demonstrations, performances, and any other course material provided by an instructor include copyright protected works. The Copyright Act and copyright law protect every original literary, dramatic, musical and artistic work, **including lectures** by University instructors. The recording of lectures, tutorials, or other methods of instruction may occur during a course. Recording may be done by either the instructor for the purpose of authorized distribution, or by a student for the purpose of personal study. Students should be aware that their voice and/or image may be recorded by others during the class. Please speak with the instructor if this is a concern for you.

Reference to Research Ethics

The two principles underlying integrity in research in a university setting are these: a researcher must be honest in proposing, seeking support for, conducting, and reporting research; a researcher must respect the rights of others in these activities. Any departure from these principles will diminish the integrity of the research enterprise. This policy applies to all those conducting research at or under the aegis of McMaster University. It is incumbent upon all members of the university community to practice and to promote ethical behaviour. To see the Policy on Research Ethics at McMaster University, please go to <https://reo.mcmaster.ca/>.

Extreme Circumstances

The University reserves the right to change the dates and deadlines for any or all courses in extreme circumstances (e.g., severe weather, labour disruptions, etc.). Changes will be communicated through regular McMaster communication channels, such as McMaster Daily News, A2L and/or McMaster email.

Notice Regarding Possible Course Modification

The instructor and university reserve the right to modify elements of the course during the term. The university may change the dates and deadlines for any or all courses in extreme circumstances. If either type of modification becomes necessary, reasonable notice and communication with the students will be given with explanation and the opportunity to comment on changes. It is the responsibility of the student to check their McMaster email and course websites weekly during the term and to note any changes.