Faculty of Engineering and Applied Science

CHEE 270 – CHEMETRONICS

Course Syllabus – Fall 2020

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

TEACHING TEAM

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COURSE INSTRUCTOR

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TEACHING ASSISTANTS

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COURSE TIMINGS

Lecture – Tuesday 10:30-11:30 online via zoom
Active Learning Session – Tuesday 2:30-5:30, online via zoom
Question and Answer Period - Thursday 1:30-2:30

COURSE INFORMATION

COURSE DESCRIPTION

This course combines elements of chemical and electrical engineering to measure, calculate and control electrical signals. The course introduces basic electrical circuit analysis theory with an emphasis on concepts utilized in analytical chemistry instrumentation and energy conversion and storage. An introduction to signal analysis, data acquisition, sampling and quantization, as well as the fundamental statistical techniques necessary to process and analyze measured data with uncertainty is given. Course content is delivered via a blended offering with on-line instruction and active learning sessions. ((0/0/0/36/0))

Prerequisites: APSC 143 (Computer Programming for Engineers), APSC 112 (Physics II)

PRE-REQUISITE KNOWLEDGE

This course is designed for learners who need to acquire fundamental knowledge and understanding of energy storage and conversion and electrical signal analysis. The concepts are applied during active learning sessions which focus on their application in analytical chemistry instrumentation and other areas of engineering chemistry.

COURSE LEARNING OUTCOMES (CLO)

CLO	DESCRIPTION	INDICATORS
CLO 1	Analyze electrical circuits utilized in analytical chemistry instrumentation.	KB-ES-ApplChem (b)
CLO 2	Compare electrical power designs related to energy conversion and storage.	KB-ES-ApplChem (b)
CLO 3	Analyze analog and digital signals.	IN-Synthesis ET-Apply
CLO 4	Select transducers for temperature, light, pressure, flow and conductivity measurements.	ET-Apply
CLO 5	Calculate uncertainty from measured data sets.	IN-Analysis
CLO 6	Apply statistical methods to single and derived data sets.	IN-Analysis
CLO 7	Design an experimental procedure and analytical instrument to obtain data required to solve a given problem.	KB-ES-ApplChem (b) IN-Conduct ET-Create

This course develops the following attributes at the 2nd year level:

Knowledge base, Engineering Science (**KB-ES**): **ApplChem (b)** Applies knowledge of electrochemistry and electrochemical engineering to analyze and design electrochemical systems and processes.

Investigation (**IN**): **Conduct** Conduct investigations to test hypotheses related to complex problems. **Analysis** Analyze and interpret data using appropriate techniques and tools. **Synthesis** Synthesize information from investigations, considering sources of uncertainty and limitations to reach substantiated conclusions.

Engineering Tools (ET): **Create** Develop, adapt and/or extend appropriate software, equipment, models, and simulations for a range of engineering activities. **Apply** Apply and manage appropriate techniques, apparatus, databases, models, tools, and/or processes to accomplish a task.

COURSE EVALUATION

DESCRIPTION

Due to the COVID-19 pandemic, the course has been moved online and will be completed over a six week timeframe. To ensure all students are progressing with the remote delivery format, all weekly evaluations (Quizzes, ALS reports, etc.) are due by Day 7 (Sunday) at 23:59 EST.

ASSESSMENT WEIGHTING

Assessment Tool	Due Date (before 23:59 EST)	Weight	Alignment with CLOs
Quizzes	**Weeks 1,2,3,4,5,6**	**20%**	**1, 2, 3, 4, 5, 6, 7**
Review Quiz	Day **7** of Week 6	2%	1
Quiz 1	Day **7** of Week 1	2%	1
Quiz 2	Day **7** of Week 1	2%	1,2
Quiz 3	Day **7** of Week 2	2%	1,2
Quiz 4	Day **7** of Week 2	2%	1,2
Quiz 5	Day **7** of Week 3	2%	1,3
Quiz 6	Day **7** of Week 3	2%	3,4,5,6,7
Quiz 7	Day **7** of Week 4	2%	3,4,6

Quiz 8	Day **7** of Week 4	2%	3,4,6
Quiz 9	Day **7** of Week 5	2%	7
Active Learning Session Reports (Individual)	**Weeks 1, 2, 3**	**20%**	**1, 2, 3, 4, 5, 6, 7**
ALS Report 1	Day **7** of Week 1	4%	1
ALS Report 3	Day **7** of Week 2	4%	1,2
ALS Report 5	Day **7** of Week 3	4%	1,3,5,6
ALS Report 6	Day **7** of Week 3	8%	3,4,5,6,7
Active Learning Session Reports (Team)	**Weeks 1, 3, 4**	**20%**	**1, 2, 3, 4, 5, 6**
ALS Report 2	Day **7** of Week 1	5%	1
ALS Report 4	Day **7** of Week 2	5%	1,2
ALS Report 7	Day **7** of Week 4	5%	3,4,6
ALS Report 8	Day **7** of Week 4	5%	2,3,4
Lab Design Project (Team)	Day **7** of Week 6	**37.5%**	7
Peer Review	Week 6	**2.5%**	**1,2,3,4,5,6**
		100%	

Assessment Descriptions

Quizzes

There are ten quizzes in the course. The quizzes are comprised of multiple choice, calculations, and short answer questions that will help to identify gaps in conceptual understanding. These quizzes are taken on the course website. You must complete the quiz prior to attending the weekly Active Learning Session. Once initiated, you have 30 minutes and one attempt to complete a quiz.

Active Learning Session Reports (Individual)

There are four individual Active Learning Session Reports. These reports will provide you with the opportunity to demonstrate your knowledge and understanding of the concepts and processes conducted in the ALS.

Active Learning Session Reports (Team)

There are four team Active Learning Session Reports. These reports will provide you with the opportunity to demonstrate your knowledge and understanding of the concepts and processes conducted in the ALS.

Lab Design Project

This is an open-ended experimental design scenario which requires students to utilize knowledge and understanding of course content. They will work in groups to come up with a design, execute the design, and get results from the experiment. This will be summarized in a report.

Peer Review

There will be one peer review to provide feedback to your design project partner on how they performed and participated as a group member throughout the design project process. A peer review tool called GRASP will facilitate this process.

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 seven days 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

- Kuphaldt, T. R. (2006). Lessons in electric circuits, volume I – DC. Retrieved from https://www.ibiblio.org/kuphaldt/electricCircuits/DC/DC.pdf (open source)

Required Calculator

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

Other Material

The following references are recommended as supplementary sources:

- Harvey, D. (2016). Analytical Chemistry 2.0. Chemistry LibreTexts. Open Text book available through eCampus Ontario
- Johnson, D. (2014). Fundamentals of Electrical Engineering I. OpenStax-CNX. Open Text book available through eCampus Ontario

All other course material is accessible via OnQ.

SUGGESTED TIME COMMITMENT

This course represents a study period of one semester which has been compressed into 6 weeks. Each week will consist of 1 hour of synchronous lecture, 3 hours of synchronous Active Learning Sessions and a one hour synchronous question and answer session. Additionally learners can expect to invest on average 2 hours per week in online readings and quizzes and 3-4 hours working asynchronously on Active Learning Sessions (ALS). Learners who adhere to a pre-determined study schedule are more likely to successfully complete the course on time.

WEEKLY COURSE OUTCOMES

Week	Learning Outcomes
	Module 1 – Electrical Circuit Analysis and Power
1.1	**Introduction to Circuits** By the end of this week, learners will be able to: • Identify symbols and nomenclature used in electrical circuits. [CLO 1,2] • Compare basic elements of an electrical circuit. [CLO 1,2] • Implement basic voltage-divider and current-divider circuits. [CLO 1,2] • Conduct measurements with a multimeter. [CLO 1,3] • Analyze circuits using Ohm's Law, Kirchoff's Current Law (KLC), and Kirchoff's Voltage Law (KVL). [CLO 1,2]
1.2	**Circuit Analysis** By the end of this week, learners will be able to:

Week	Learning Outcomes
	• Investigate the circuit design of various metering devices. [CLO 1, 2] • Compare the operation of different types of operational amplifiers. [CLO 1,2] • Utilize node-voltage and mesh-current methods to solve circuits. [CLO 1,2,3] • Examine how different circuits are used in Analytical Chemistry equipment. [CLO 1,3]
2.1	**Capacitors & Inductors** By the end of this week, learners will be able to: • Investigate how a capacitor behaves and the requirement to have continuous voltage. [CLO 1,2] • Investigate how an inductor behaves and the requirement to have continuous current. [CLO 1,2] • Solve simple circuits containing capacitors and inductors to find voltage, current and power. [CLO 1,2,3]
2.2	**AC Three-Phase Power, Transformers & Microgrids** By the end of this week, learners will be able to: • Investigate the difference between AC and DC power. [CLO 2] • Analyze a balanced 3 phase circuit. [CLO 2,3] • Calculate average, reactive and complex power in three-phase circuits. [CLO 2,3] • Examine impedance and transmission lines. [CLO 2,3] • Examine mutual inductance transformers. [CLO 2,3]

Module 2 – Data Acquisition and Analysis (Arduino)	
3.1	**Introduction to Arduinos, Analog and Digital Signals** By the end of this week, learners will be able to: • Identify various transducers and their function. [CLO 4] • Construct basic circuits for simple transducers. [CLO 1,4] • Execute a simple program on your own Arduino, using IDE software on your computer. [CLO 3] • Collect data from digital sensors. [CLO 1,3,4] • Interpret the output from an analog sensor on your Arduino, convert the ADC value to a voltage. [CLO 1,3,4] • Calculate means and standard deviations for sets of data points. [CLO 5] • Make estimates of uncertainty and noise in our measurements and average or smooth that noise to improve the accuracy of our time series. [CLO 3,4,5,6]
3.2	**Colorimetry Design** By the end of this week, learners will be able to: • Design a colorimeter to take irradiance readings of a sample [CLO 7] • Record time series data from our transducers with a microcontroller. [CLO 3,4] • Calculate means and standard deviations for sets of data points. [CLO 5,6] • Create calibration curves for a series of solutions with varying concentrations [CLO 3,4,5,6]
4.1	**Introduction to MATLAB GUIs** By the end of this week, learners will be able to: • Develop MATLAB GUIs [CLO 7] • Collect data from analog sensors. [CLO 1,3,4] • Use time series data to determine sensor constants. [CLO 6]
4.2	**I^2C Sensors and MATLAB GUIs** By the end of this week, learners will be able to: • Read I2C devices using Arduino IDE and MATLAB GUIs [CLO 1,3,4] • Calibrate analog sensors in MATLAB [CLO 3] • Calculate density using temperature, pressure and humidity readings [CLO 3,6] • Design a MATLAB GUI [CLO 7]

Module 3 – Experimental Design Project	
5-6	**Experimental Design Project** By the end of this week, learners will be able to: • Develop an experimental procedure which will produce the required data to solve the problem provided. [CLO 7] • Utilize transducers, circuits and a microcontroller to develop an analytical instrument which can acquire the required measurements. [CLO 4] • Assess the accuracy of your designed experiment. [CLO 6]

Late Policy

Any applicable late penalties are described in the details for each assessment. In the event of extenuating circumstances, you may request an extension to an assignment due date without penalty. Requests must be made to your instructor prior to the original due date of the assignment, and some substantiating documentation is often required. Note that unacceptable reasons include malfunctioning computer, travel plans to go home for holidays, generally behind on schoolwork, etc. In the absence of substantiating documentation, the normal late penalty will apply as described in the assignment or departmental policies.

COURSE COMMUNICATION

Questions About Course Material

Questions or comments regarding the course material that can be of benefit to other students should be posted in the discussion forum in OnQ. 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 class website.

Office Hours

In addition to interaction in the Q&A discussion forums, you will have the opportunity to interact in a synchronous fashion with either a TA or the instructor during the Thursday Question and Answer session.

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.

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 and in some cases within 24 hours.

COURSE POLICIES

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

COPYRIGHT

Unless otherwise stated, the material on the course website is copyrighted and is for the sole use of students registered in CHEE 270. The material on the website may be downloaded for a registered student's personal use but shall not be distributed or disseminated to anyone other than students registered in this course.

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 exams, impersonating another student, copying from another student, making information available to another student about the exam questions or possible answers, communicating with another person during an exam or about an exam during the exam window, or accessing 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 may request an extension to an assignment due date without penalty. Requests must be made to your instructor prior to the original due date of the assignment, and some substantiating documentation is often required (see information below on absences). Note that unacceptable reasons include extra-curricular activities, travel plans, generally behind on schoolwork, etc. In the absence of substantiating documentation, the normal late penalty will apply as described in the assignment or departmental policies.

Absences (Academic Considerations) and Academic Accommodations

(STANDARD TEXT): 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/
RocScience	https://www.rocscience.com/
Google Spreadsheets	https://www.google.com/accessibility/products-features/

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. Please note that Rosh Hashanah falls on the eve of September 18, 2020 so students in need of accommodation should speak to their professors right away. 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 Chaplain Kate Johnson 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.

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 109 countries around the world. You belong here: https://www.queensu.ca/inclusive/.