ELEC ENG 2CI4
Introduction to Circuit Analysis

COURSE OUTLINE

Please refer to course website for updated information.

COURSE DESCRIPTION

Current, potential difference; Kirchhoff's laws; Ohm's law; circuit elements; mesh/nodal analysis of electrical circuits; Thevenin and Norton equivalent circuits; maximum power transfer; first and second order circuits; complex arithmetic; phasors, impedance and admittance; AC power.

Three lectures, one tutorial, one lab (every other week); first term.

PRE-REQUISITES AND ANTI-REQUISITES

Pre-requisite(s): Registration in a Computer Engineering or Electrical Engineering program

Anti-requisite(s): ELECENG 2CI5

SCHEDULE and MODE OF DELIVERY

The material for this course will be delivered through a mixture of textbook readings, classroom lessons, tutorials (for problem solving), laboratories, and homework AD3 experiments. Classroom lessons, tutorials, and laboratories will take place in-person unless otherwise notified. Classroom lessons and tutorials will not be recorded. Labs may have online pre-lab videos that must be watched before the respective lab session.

Lectures:

Section C01 – Mondays 11:30 am – 12:20 pm, Wednesdays 11:30 am – 12:20 pm, and Fridays 1:30 pm – 2:20 pm – In-person.

Section C02 – Mondays 5:30 pm – 6:20 pm, Wednesdays 5:30 pm – 6:20 pm, and Fridays 5:30 pm – 6:20 pm – In-person.

Tutorials:

Section T01 – Fridays 12:30 pm to 1:20 pm – In-person.

Section T02 – Wednesdays 12:30 pm – 1:20 pm – In-person.

Labs: There will be five in-person lab sessions (every other week) according to the schedule given below for the various lab sections.

L01 Mondays	2:30 pm – 5:20 pm (Sept 29, Oct 20, Nov 3, Nov 17, Dec 1)
L02 Mondays	2:30 pm – 5:20 pm (Sept 22, Oct 6, Oct 27, Nov 10, Nov 24)
L03 Tuesdays	2:30 pm – 5:20 pm (Sept 16, Oct 21, Nov 4, Nov 18, Dec 2)
L04 Tuesdays	2:30 pm – 5:20 pm (Sept 23, Oct 7, Oct 28, Nov 11, Nov 25)
L05 Wednesdays	2:30 pm – 5:20 pm (Oct 1, Oct 22, Nov 5, Nov 19, Dec 3)
L06 Wednesdays	2:30 pm – 5:20 pm (Sept 24, Oct 8, Oct 29, Nov 12, Nov 26)
L07 Thursdays	2:30 pm – 5:20 pm (Oct 2, Oct 23, Nov 6, Nov 20, Dec 4)
L08 Thursdays	2:30 pm – 5:20 pm (Sept 25, Oct 9, Oct 30, Nov 13, Nov 27)
L09 Fridays	2:30 pm – 5:20 pm (Sept 19, Oct 3, Oct 24, Nov 7, Nov 21)

All laboratories must be completed to pass the course.

INSTRUCTOR

Dr. Shahrukh Athar
E-mail: athars3@mcmaster.ca
Office: ITB A317
Phone: 905-525-9140 ext. 26503
Office Hours: See course website for details.

When emailing the instructor, please ensure that your email subject starts with "EE2CI4:" and include in the body of the message your name, student number, lab section, and class section. Please include prior correspondence and endeavour to keep your emails concise. You must send emails from your *@mcmaster.ca* account.

TEACHING ASSISTANTS

Names, contact information and office hours are provided on the course website.

COURSE WEBSITE/S

McMaster Avenue to Learn: http://avenue.mcmaster.ca

COURSE OBJECTIVES

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

- Analyze circuits using Ohm's law, Kirchhoff's laws, nodal analysis, loop/mesh analysis, superposition, Thevenin's theorem and Norton's theorem.

- Interpret analytical results and properly assign power, current, and voltage to circuit elements.
- Explain the characteristics of resistors, capacitors, and inductors.
- Compute time response of first-order RC and RL circuits.
- Analyze RLC circuits using phasor techniques, interpret analytical results, and properly assign power, current, and voltage to circuit elements.
- Work in a group in an effective and efficient manner to achieve goals of assigned laboratory work.
- Clearly communicate engineering design work in both written and oral formats.

CEAB GRADUATE ATTRIBUTES (GAS)

Note: The CEAB Graduate Attributes (GAs) defined in this section are measured throughout the course and form part of the Department's continuous improvement process. They are a key component of the accreditation process for the program and will not be taken into consideration in determining a student's actual grade in the course. For more information on accreditation, please ask your instructor or visit: http://www.engineerscanada.ca

Attributes	Indicators		Measurement Method(s)
	Number	Description	
Knowledge Base for Engineering	1.1	Competence in Mathematics	Exams
Problem Analysis	2.1	Identifies and states reasonable assumptions and suitable engineering fundamentals, before proposing a solution path to a problem.	Exams, Labs, AD3 Homework
Problem Analysis	2.2	Proposes problem solutions supported by substantiated reasoning, recognizing the limitations of the solutions.	Exams, Labs, AD3 Homework
Investigation	3.1	Selects appropriately from relevant knowledge base to plan appropriate data collection methods and analysis strategies.	Exams, Labs, AD3 Homework
Investigation	3.2	Synthesizes the results of an investigation to reach valid conclusions.	Labs

ASSUMED KNOWLEDGE

Linear algebra, basic complex algebra, first-order and second-order differential equations, electricity and magnetism.

COURSE MATERIALS

Required Text:
Basic Engineering Circuit Analysis (12th Ed.) by J. David Irwin and R. Mark Nelms, Wiley. Available at the McMaster Campus Store through the Immediate Access (IA) program. A few loose-leaf copies are also available.

Required Equipment:
1. Analog Discovery 3 (AD3) kit
2. ELECENG 2CI4 components kit
3. Breadboard and Jumper kit

Available at the McMaster Campus Store.

Calculator: Only the McMaster Standard Calculator will be permitted in tests and exams. The McMaster Standard Calculator is the Casio FX-991 MS or Casio FX-991 MS Plus.

Additional Resource (Optional):
Dr. Mohamed Bakr's lecture videos from a previous offering of ELECENG 2CI5 are available at his YouTube Channel: **http://www.youtube.com/channel/UCFQ_5eallhvHplhf9pdsVsw**

COURSE OVERVIEW

Weeks	Topics	Textbook
1	Charge, current, voltage and power. Voltage and current sources.	Chapter 1
2-3	Resistive circuits, Ohm's law, Kirchhoff's laws, voltage and current dividers, parallel and series circuits, Wye and delta circuits.	Chapter 2
4-5	Nodal and Loop/Mesh analysis techniques.	Chapter 3
6-7	Linearity, Superposition technique in linear circuits. Thevenin and Norton theorems, and equivalent circuits. Maximum Power transfer.	Chapter 5
8	Capacitance and inductance, energy storage, integrator and differentiator circuits.	Chapter 6
9-10	Transient circuit analysis (first-order and second-order circuits).	Chapter 7
11-12	Forcing functions, Phasors, Impedance, AC steady-state analysis.	Chapter 8
13	AC power.	Chapter 9

A more detailed timeline is available on Avenue to Learn. At certain points in the course, it may make good sense to modify the schedule. The instructor may modify elements of the course and will notify students accordingly (in class, on Avenue).

LABORATORY OVERVIEW

Labs are NOT held during the first or second weeks of term.

Labs 2-5 have two components: 1) In-lab construction and analysis of circuits (evaluated by TAs), 2) Lab report. Lab 1 does not have a lab report component. **Attendance is mandatory in ALL labs.**

When attending labs, the student must attend the assigned room and section (see Page 2 of this outline). Attendance will be taken. **Lab reports (hard copy) are due at the end of the session.** A laboratory exercise deemed to be partially or fully copied will be considered an academic offence and will be subject to the terms laid out under the McMaster Academic Integrity Policy.

It is a mandatory requirement that students must complete ALL five labs to successfully complete the course. If even a single lab is missed, then a grade of F will be awarded in the course.

An overview of lab topics is given in the table below.

Lab	Topic
1	Laboratory Safety. Familiarization with lab equipment, electrical signals, and circuits.
2	Resistors and resistive networks.
3	Thevenin equivalent circuits.
4	Capacitors and resistor/capacitor networks; Introduction to PSpice.
5	Inductors and resistor/inductor networks (also with PSpice and AD3).

LABORATORY OPERATION

- Each student in the course is required to pass the lab safety quiz prior to attempting any of the laboratories. The quiz will be available on Avenue to Learn.
- Access to all labs is restricted in the interest of security and safety. Information on accessing and safely using the lab can be found on the webpage: https://www.eng.mcmaster.ca/ece/resources/health-safety-labs/
- **Lab Experiments:** Students must conduct the lab experiments in-person in groups of two.
- **Lab Requirements:** Students must submit their experimental results as a report (hard copy) at the end of their in-person lab session to the supervising TAs. No late submission will be accepted.
- **Note:** No food or drink is permitted in the lab. Please keep the lab clean.

AD3 HOMEWORK EXPERIMENTS OVERVIEW

There will be three Analog Discovery 3 (AD3) based homework experiments in the term.

No.	Released	Deadline	Topic
1	Sept 26	Oct 20	Introduction to the AD3 kit and working with resistors (Sets 1 - 3).
2	Oct 21	Nov 7	Nodal and Mesh Analyses (Sets 4 - 5).
3	Nov 10	Nov 28	Build RLC circuits and verify their operation with PSpice and AD3.

Note:

- The *AD3 Experiments Manual for ELECENG 2CI4* contains the *Sets* of experiments mentioned above. This manual will be uploaded on Avenue to Learn.
- Students will work in pairs such that every student must first conduct the AD3 homework experiments **individually**, then compare their work with their partner, and finally each pair will submit one report in the relevant Avenue to Learn Dropbox by the due date as mentioned in the table above.
- No late submission will be accepted.

ASSESSMENTS AND ASSOCIATED POLICIES

Component	Weight
Laboratories (5)	25 % (5% each) *
AD3 Homework Experiments (3)	10 % (HW1: 4%; HW2: 3%; HW3: 3%)
Midterm Exam (1)	25 %
Final Exam (1)	40 %
Total	100%

* All labs are compulsory to attend and complete to pass the course; Passing the *Lab Safety Quiz* in Lab 1 is mandatory to receive marks in subsequent labs.

Students are expected to attend all classes and tutorials, as well as their assigned laboratory section. Students will be responsible for all material covered in these venues.

Grading and Evaluation Policies

- There are five (5) labs, three (3) AD3 Homework experiments, one (1) mid-term exam, and one (1) final exam to be evaluated in this course.
- Use of books, notes, other copied materials, computers or cell phones is not allowed during exams, unless otherwise notified.

- The final exam must be written else a final grade of F will be awarded with the notation DNW (Did Not Write) regardless of the student's course aggregate achieved without the final exam.
- **To pass the course a student must obtain at least 30% marks on the final examination.**
- Statistical adjustments (such as bell curving) will not normally be used.
- No make-up midterm tests will be granted. Weight of a missed midterm test will be transferred to the final exam only after an approved MSAF is received.
- If a student achieves a higher grade on the final exam compared to the midterm, then the midterm mark will be replaced by the final exam mark. However, this does not apply to a missed midterm exam in which case an approved MSAF will be required to transfer the midterm weight to the final exam (see the point above).
- In a case where the component weight cannot be fulfilled as a result of unforeseen and/or uncontrollable circumstance(s) in the course operation or execution, the grades assigned to that component may be pro-rated.

See Avenue to Learn for dates, times, and instructions for Midterm Exam and Final Exam.

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 this link.

The following illustrates only a few 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.
- In case a course is being repeated, submitting work done earlier by the student may constitute self-plagiarism. Students should discuss with the instructor for clarity.
- Improper collaboration in group work.
- Copying or using unauthorized aids in tests and examinations.
- Using generative AI tools to do work that is to be submitted for credit if the instructor has prohibited such use.

Note: The use of generative AI tools (such as ChatGPT) is prohibited in this course unless explicitly allowed by the instructor. Any violation in this regard will constitute academic dishonesty.

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 this link.

COURSES WITH AN ON-LINE ELEMENT

Some courses may use on-line elements (e.g., e-mail, Avenue to Learn (A2L), LearnLink, 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, usernames 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 on-line 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.

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.

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.

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, Microsoft Teams, WebEx or Zoom 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 ACCOMMODATIONS

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.

Students requiring academic accommodations 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.

REQUESTS FOR RELIEF FOR MISSED ACADEMIC 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". The applicable policy is located at this link.

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.

www.eng.mcmaster.ca/ece

Electrical and Computer Engineering Lab Safety

Information for Laboratory Safety and Important Contacts

This document provides important information for the healthy and safe operation of ECE instructional laboratories. This document is required reading for all laboratory supervisors, instructors, researchers, staff, and students working in or managing instructional laboratories in ECE. It is expected that revisions and updates to this document will be done continually. A McMaster University lab manual is also available to read in every laboratory and online at this link.

General Health and Safety Principles

Good laboratory practice requires that every laboratory worker and supervisor observe the following whether conducting lab work at school or at home:

1. Food and beverages are not permitted in the instructional laboratories.
2. A Laboratory Information Sheet on each lab door identifying potential hazards and emergency contact names should be known.
3. Laboratory equipment should only be used for its designed purpose.
4. Proper and safe use of lab equipment should be known before using it.
5. The course TA leading the lab should be informed of any unsafe condition.
6. The location and correct use of all available safety equipment should be known.
7. Potential hazards and appropriate safety precautions should be determined, and sufficiency of existing safety equipment should be confirmed before beginning new operations.
8. Proper waste disposal procedures should be followed.
9. Personal ergonomics should be practiced when conducting lab work. Please see this link.
10. Current University health and safety issues, and protocols should be known. Please see this link.

Location of Safety Equipment

Fire Extinguisher
On walls in halls outside of labs

First Aid Kit
Main Lobby of ITB or dial “88” after 4:30 p.m.

Telephone
On the wall of every lab near the door

Fire Alarm Pulls
Near all building exit doors on all floors

Who to Contact

Emergency Medical / Security: On McMaster University campus, call Security at extension **88** or **905-522-4135** from a cell phone.

Non-Emergency Accident or Incident: Immediately inform the TA on duty or Course Instructor.

University Security (Enquiries / Non-Emergency): Dial 24281 on a McMaster phone or dial 905-525-9140 ext. 24281 from a cell phone.

See TA or Instructor: For problems with heat, ventilation, fire extinguishers, or immediate repairs.

Environmental & Occupational Health Support Services (EOHSS): For health and safety questions dial 24352 on a McMaster phone or dial 905-525-9140 ext. 24352 from a cell phone.

ECE Specific Instructional Laboratory Concerns: For non-emergency questions specific to the ECE laboratories, please contact 24103.

In Case of a Fire (On Campus Dial 88)

When calling to report a fire, give name, exact location, and building.

1. Immediately vacate the building via the nearest Exit Route. Do not use elevators!
2. Everyone is responsible for knowing the location of the nearest fire extinguisher, the fire alarm, and the nearest fire escape.
3. The safety of all people in the vicinity of a fire is of foremost importance. But do not endanger yourself!
4. In the event of a fire in your work area shout “*Fire!*" and pull the nearest fire alarm.
5. Do not attempt to extinguish a fire unless you are confident it can be done in a prompt and safe manner utilizing a hand-held fire extinguisher. Use the appropriate fire extinguisher for the specific type of fire. Most labs are equipped with Class A, B, and C extinguishers. Do not attempt to extinguish Class D fires which involve combustible metals such as magnesium, titanium, sodium, potassium, zirconium, lithium, and any other finely divided metals which are oxidizable. Use a fire sand bucket for Class D fires.

6. Do not attempt to fight a major fire on your own.
7. If possible, make sure the room is evacuated; close but do not lock the door and safely exit the building.

Clothing on Fire

Do not use a fire extinguisher on people.

1. Douse with water from safety shower immediately or
2. Roll on floor and scream for help or
3. Wrap with fire blanket to smother flame (a coat or other non-flammable fiber may be used if blanket is unavailable). Do not wrap a standing person; rather, lay the victim down to extinguish the fire. The blanket should be removed once the fire is out to disperse the heat.

Equipment Failure or Hazard

Failure of equipment may be indicative of a safety hazard - You must report all incidents.

Should you observe excessive heat, excessive noise, damage, and/or abnormal behaviour of the lab equipment:

1. Immediately discontinue use of the equipment.
2. In power labs, press wall-mounted emergency shut-off button.
3. Inform your TA of the problem.
4. Wait for further instructions from your TA.
5. TA must file an incident report.

Protocol For Safe Laboratory Practice

In general, leave equipment in a safe state when you finish with it. When in doubt, consult the course TA.

Defined Roles

TA	The first point of contact for lab supervision	
ECE Lab Supervisor	Steve Spencer - ITB 147	spencers@mcmaster.ca
ECE Chair	Dr. Shahram Shirani - ITB A111	shirani@mcmaster.ca
ECE Administrator	Shelby Gaudrault - ITB A111	gaudraus@mcmaster.ca
ECE Course Instructor	Please contact your specific course instructor directly	