ECE 110S – Electrical Fundamentals

Course Information

Winter 2023

1 Contacts

Instructor	email	Office Hours
Paul Yoo, Coordinator	paul.yoo@utoronto.ca	TBD
Berj Bardakjian	berj.bardakjian@utoronto.ca	TBD
Mo Mojahedi	mojahedi@waves.utoronto.ca	TBD
Belinda Wang	belinda.wang@utoronto.ca	TBD
Xilin Liu,	xilinliu@ece.utoronto.ca	TBD
Daniel Tovbis, Head TA	daniel.tovbis@utoronto.ca	TBD

1.1 Discussion Board (*Piazza*)

We will use Piazza for the class discussion board. Piazza is connected through Quercus. For information on joining the Piazza site for this course, please see the document ***Piazza- Quercus Student Experience.pdf***, under the "Course Information" module.

Please post all your course-related questions to Piazza as it is quite likely others will have the same question and it is good to have the responses available to everyone. If you have a personal issue, please contact one of the instructors directly.

Class signup link: https://piazza.com/utoronto.ca/winter2023/ece110

2 Required Text

Title: Custom Print "Fundamentals of Physics" + "Basic Engineering Circuit Analysis"
Authors: D. Halliday, R. Resnick, J. Walker and J.D. Irwin, R.M. Nelms
Publisher: Wiley

1. Halliday/Irwin print custom textbook, WP access for Halliday, and Irwin enhanced etextbook – (ISBN: **9781119894247**) - $139.95
2. Irwin enhanced etextbook + Halliday WP access (ISBN: **9781119893363)** - $65

Instructions for purchasing can be found on Quercus (see Word document in the Course Information section). Please visit or contact the UofT Bookstore for purchasing a physical copy.

The following link for WileyPLUS purchase instructions.
https://wileyplus.gallery.video/student/detail/videos/registration-videos/video/4950839906001/first-day-of-class---getting-started-with-wileyplus-and-canvas-student?autoStart=true

Please Note: it's mandatory for every student to have a WileyPLUS access code. If there is a problem with accessing your WileyPLUS account you can contact https://support.wileyplus.com/s/contactsupport first and then the Head TA, Daniel Tovbis at daniel.tovbis@utoronto.ca if your issue persists.

3 Calendar Description

Fixed Credit Value: 0.50
Hours: 38.4L/38.4P

An overview of the physics of electricity and magnetism: Coulomb's law, Gauss' law, Ampere's law, Faraday's law, Lenz's law, and Ohm's law. Physics of capacitors, resistors, and inductors. An introduction to circuit analysis: resistive circuits, nodal and mesh analysis, linearity and superposition, Thévenin's and Norton's theorems, maximum power transfer, first-order RC and RL transient response, and sinusoidal steady-state analysis.

4 Learning Outcomes

Learn the laws govern the behaviors of electric charges, and interactions between charges. Understand the concepts of electric fields, electric potentials and electric potential energies.

Learn about electrical energy storing elements, such as capacitors, and then use them in various electrical circuits.

Learn about magnetism, magnetic forces on moving electric charges and on current carrying wires. Learn about the concept of magnetic fields, magnetic energy, and magnetic energy storing devices such as inductors. Understand how inductors behave in electrical circuits.

Learn about basic circuit elements such as power supply, resistor, capacitor and inductor. Learn how to analyze resistive circuits under DC excitation. Learn about various circuit analysis techniques: Kirchhoff's law, current/voltage division rules, nodal/mesh analysis, and superposition principles.

Learn the roles of a capacitor and an inductor in RC and RL transient circuits respectively, and the step-by-step technique in analyzing first-order transient circuits.

Learn about the concepts of phasors and impedances, and use them to analyze sinusoidal steady-state (AC) circuits.

Learn about Thevenin's and Norton's theorems and their significance in circuit analysis. Apply Thevenin/Norton theorems and maximum power transfer theorem to resistive networks (DC) and sinusoidal steady-state (AC) circuits.

5 Real-World Relevance

Electric charges are everywhere in our physical world and electromagnetic energy powers our modern existence. The materials covered in this course teach you something about the fundamental particles (electric charges) that are ubiquitous in our world and their awesome power that we cannot live without.

6 Structure

	Format	Number	Hours/week
Lectures	In-person	38/39	3
Office Hours	TBD	12	1
Tutorials	In-person	12	2
Labs	In-person	-	-

Office hours will be determined based on student input.

The weekly tutorials are integral part of this course. A teaching assistant will lead the tutorial. The TA will review the materials covered in the week, and then solve a few selected problems. Students can interact with the TA during the session to discuss problems in the assignments. The tutorials will start in the second week of the semester (**week of January 16, 2021)**. You can see the file ***Tutorial Schedule.pdf*** under the "Course Information" module for more details.

The labs are important part of this course and is where you gain hands-on experience using electronic instruments, building and testing circuits.

7 Lecture Timetable

All lectures will be delivered in-person. Please confirm your lecture section and lecture rooms.

Lectures			
Section 101 Prof. Xilin Liu	T 5 – 6 pm	W 5 – 6 pm	F 5 – 6 pm
Section 102 Prof. Xilin Liu	T 4 – 5 pm	W 4 – 5 pm	F 4 – 5 pm
Section 103 Prof. Berj Bardakjian	T 4 – 5 pm	W 4 – 5 pm	F 4 – 5 pm
Section 104 Prof. Belind Wang	T 10 – 11 am	Th 10 – 11 am	F 9 – 10 am
Section 105 Prof. Paul Yoo	M 12 – 1 pm	W 12 – 1 pm	F 2 – 3 pm
Section 106 Prof. Mo Mojahedi	M 3 – 4 pm	W 3 – 4 pm	Th 3 - 4 pm

Assignment Due Dates:

There are 7 online (auto-graded) assignments. Student can access these assignments through the "Assignments" module. Similar problems can also be found in the end-of-chapter-problems sections of the textbook. **The Head TA (Daniel Tovbis: daniel.tovbis@utoronto.ca) will handle student inquiries related to assignments.**

Assignment 0: not graded, but essential practice to learn how to use the Assignment software (the same system will be used for all online assessments in this course), **especially the "SHOW WORK" feature which will be used for submitting written work (optional) during assessments.**

Assignment 1: January 28, 2023
Assignment 2: February 11, 2023
Assignment 3: March 4, 2023
Assignment 4: March 18, 2023
Assignment 5: April 1, 2023
Assignment 6: April 8, 2023
Assignment 7: April 15, 2023

8 Grade Composition

Not-closely supervised work	15%
Term Test 1	20%
Term Test 2	20%
Final Exam	45%
Total	100%

9 Assessment Scheme

Typically the term test will take **1.5 hours** and the final assessment will take **2.5 hours**. More details will be posted in due course.

Note: The Final Assessment is mandatory in order to complete the course. In another word, if you decide to skip the Final Assessment, you will receive incomplete (INC) for the course.

10 Course Outline

There are three main goals of this course:

1. To understand basic laws governing the physical behaviors of electric charges, fundamental principles of electricity and magnetism, and functionalities of circuit elements.
2. To become comfortable applying fundamental laws of physics to study the behaviors of electric charges.
3. To become comfortable using various methods and techniques to analyze electrical circuits.

The lecture outline below is only approximate. The actual topics and lecture schedule may vary.

Lec	Week	Topics	Sections	Sections	Important Dates
1	Jan. 9	Course introduction, Coulomb's law	Halliday (11th Ed., Text Book) **21**-1	Halliday (11th Ed., WileyPlus) **1**-1, 2, 3	
2		Coulomb's law, Charge is quantized, Charge is conserved, Conductors and insulators	**21**-1	**1**-1, 2, 3	
3		The electric field, The electric field due to a charged particle, A point charge in an electric field	**22**-1, 2, 6	**2**-1, 2, 6	
4	Jan. 16	Electric flux, Gauss law, A charged isolated conductor	**23**-1, 2,3	**3**-1, 2,3	
5		Applying Gauss law (cylindrical, planar, and spherical symmetry)	**23**-4, 5, 6	**3**-4, 5, 6	
6		Electric potential, Equipotential surfaces and the electric field	**24**-1, 2	**4**-1, 2	
7	Jan. 23	Potential due to a charged particle, Electric potential energy of a system of charged particles	**24**-3, 7	**4**-3, 7	
8		Capacitance, Calculating the capacitance	**25**-1, 2	**5**-1, 2	
9		Capacitors in parallel and series, Energy stored in an electric field, Capacitor with a dielectric	**25**-3, 4, 5	**5**-3, 4, 5	Assign 1 due, Jan. 28
10	Jan. 30	Electric current, Current density, Resistance and resistivity, Ohm's law (excluding: A microscopic view of Ohm's law), Power in electric circuits (excluding: semiconductors and superconductors)	**26**-1, 2, 3, 4, 5	**6**-1, 2, 3, 4, 5	
11		Review on electricity (catch-up lecture)			
12		Magnetic fields and definition of B, Magnetic force on a current-carrying wire	**28**-1, 6	**7**-1, 6	
13	Feb. 7	Magnetic field due to a current, Force between two parallel currents	**29**-1, 2	**8**-1, 2	
14		Ampere's law, Solenoids (excluding: Toroids)	**29**-3, 4	**8**-3, 4	
15		Faraday's law and Lenz's law	**30**-1	**9**-1	Assign 2 due, Feb. 11
16	Feb. 14	Induction and energy transfers	**30**-2	**9**-2	
17		Inductors and inductance, Self-induction, Energy stored in magnetic field (inductor), Series and parallel connections of inductors	**30**-4, 5, 7	**9**-4, 5, 7	**Test-1, Feb. 16 5:10-6:40 pm** Lec 1–14 inclusive
18		Review on magnetism (catch-up lecture)			
	Feb. 21	Reading Week			
19	Feb. 28	System of units, Basic quantities, Circuit elements, Ohm's law, Kirchhoff's laws	Irwin (11th Ed., Text book) **1.**1, 2, 3, **2.**1, 2	Irwin (11th Ed., WileyPlus) **10.**1, 2, 3, **11.**1, 2	
20		Single-loop circuits (voltage divider), Single-node-pair circuits (current divider), Series and parallel resistor combinations	**2.**3, 4, 5	**11.**3, 4, 5	Assign 3 due, Mar. 4
21		Nodal analysis	**3.**1	**12.**1	

Lec	Week	Topics	Sections	Sections	Important Dates
22	Mar. 6	Loop analysis	**3.**2	**12.**2	
23		Nodal/loop analyses (dependent sources)	**3.**1, 2	**12.**1, 2	
24		Equivalence, Linearity, Superposition	**5.**1, 2	**13.**1, 2	
25	Mar. 13	More on superposition	**5.**2	**13.**2	
26		Thevenin's and Norton's theorems	**5.**3	**13.**3	
27		More on Thevenin's/Norton's theorem's (dependent sources)	**5.**3	**13.**3	Assign 4 due, Mar.18
28	Mar. 20	Maximum power transfer	**5.**4	**13.**4	
29		Review on DC circuits (catch-up lecture)			
30		Capacitors, Inductors, Capacitor and Inductor combination (series and parallel combinations)	**6.**1, 2, 3	**14.**1, 2, 3	**Test-2, Mar. 23 6:10-7:40pm** Covers Lec 15–27 inclusive
31	Mar. 27	First-order circuits (step-by-step technique)	**7.**1, 2	**15.**1, 2	
32		More on first-order circuits	**7.**2	**15.**2	
33		Sinusoids	**8.**1	**16.**1	Assign 5 due, Apr. 1
34	Apr. 3	Review of complex numbers	Appendix	Appendix	
35		Sinusoidal and complex forcing Functions, Phasors	**8.**2, 3	**16.**2, 3	
36		Phasor relationships for circuit elements, Impedance and admittance	**8.**4, 5	**16.**4, 5	Assign 6 due, Apr. 8
37	Apr. 10	Basic Analysis using Kirchhoff's laws	**8.**7	**16.**7	
38		More on AC circuits	**8.**7	**16.**7	
39		Course review			Assign 7 due, Apr. 15

11 Notice of video recording and sharing (Download permissible; re-use prohibited)

At times during this course, some interactions including your participation, may be recorded on video and will be available to students in the course for viewing remotely and after each session.

Course videos and materials belong to the instructors, the University, and/or other source depending on the specific facts of each situation and are protected by copyright. In this course, you are permitted to download session videos and materials for your own academic use, but you should not copy, share, or use them for any other purpose without the explicit permission of the instructor. For questions about recording and use of videos in which you appear, please contact your instructor.

12 Academic Integrity Policies

http://www.academicintegrity.utoronto.ca/
https://governingcouncil.utoronto.ca/secretariat/policies/code-behaviour-academic-matters-july-1-2019

13 Land Acknowledgement

I (we) wish to acknowledge this land on which the University of Toronto operates. For thousands of years, it has been the traditional land of the Huron-Wendat, the Seneca, and most recently, the Mississaugas of the Credit River. Today, this meeting place is still the home to many Indigenous people from across Turtle Island and we are grateful to have the opportunity to work on this land.

14 Inclusivity, Accommodations and Mental Health Support

14.1 Statement on Inclusivity

You belong here. The University of Toronto commits to all students, faculty and staff that you can learn, work and create in a welcoming, respectful and inclusive environment. In this class, we embrace the broadest range of people and encourage their diverse perspectives. This team environment is how we will innovate and improve our collective academic success. You can read the evidence for this approach here.

We expect each of us to take responsibility for the impact that our language, actions and interactions have on others. Engineering denounces discrimination, harassment and unwelcoming behaviour in all its forms. You have rights under the Ontario Human Rights Code. If you experience or witness any form of harassment or discrimination, including but not limited to, acts of racism, sexism, Islamophobia, anti-Semitism, homophobia, transphobia, ableism and ageism, please tell someone so we can intervene. Engineering takes these reports extremely seriously. You can talk to anyone you feel comfortable approaching, including your professor or TA, an academic advisor, our Assistant Dean, Diversity, Inclusion and Professionalism, the Engineering Equity Diversity and Inclusion Action Group, any staff member or a U of T Equity Office.

You are not alone. Here you can find a list of clubs and groups that support people who identify in many diverse ways. Working together, we can all achieve our full potential.

14.2 Statement on Accommodations

The University of Toronto supports accommodations for students with diverse learning needs, which may be associated with mental health conditions, learning disabilities, autism spectrum, ADHD, mobility impairments, functional/fine motor impairments, concussion or head injury, blindness and low vision, chronic health conditions, addictions, deafness and hearing loss, communication disorders and/or temporary disabilities, such as fractures and severe sprains, or recovery from an operation.

If you have a learning need requiring an accommodation, the University of Toronto recommends that students register as soon as possible with Accessibility Services.
Phone: 416-978-8060

Email: accessibility.services@utoronto.ca

In this course, we do not have makeup assignments or tests. However, if you missed some assigned tasks, some considerations may be given, as described below. It is very important to note that these considerations will be applicable if and only if there are legitimate reasons **(e.g. sickness, car accident,…). Student must submit the required online petition with the supporting documents to the First-Year Office**.

14.2.1 Missing Assignments:
There are **seven assignments** in this course. All assignments run over many days. If you missed no more than four assignments, we will use the marks of the remaining assignments to calculate your overall assignment grade. If you missed five assignments, we will use the marks of the remaining two assignments minus 20% to calculate your overall assignment grade. If you missed six assignments, we will use the marks of the remaining assignment minus 30% to calculate your overall assignment grade. If you missed all seven assignments, you will receive zero for the assignment grade.

14.2.2 Missing Term Tests:
There are **two term tests** in this course. If you missed one term test, we will use your final assessment mark to calculate your marks for the missed term test. You must keep in mind that the final assessment is cumulative (it includes all the materials covered in the course) and more substantial than the term tests. If you missed both term tests, your Final Assessment will be worth 60% and you will be given an oral test worth 25% of the course grade.

Important Notice: In the case of unfortunate and unforeseen circumstances such as long-term hospitalization, chronical heath issues or similar difficulties, which causes you to miss many of the course assignments and tests, **please contact your course instructor and the course coordinator as soon as possible to discuss your situation and possible available options.**

14.3 Statement on Mental Health

As a university student, you may experience a range of health and/or mental health challenges that could result in significant barriers to achieving your personal and academic goals. Please note, the University of Toronto and the Faculty of Applied Science & Engineering offer a wide range of free and confidential services that could assist you during these times.

As a U of T Engineering student, you have an Academic Advisor (undergraduate students) or a Graduate Administrator (graduate students) who can support you by advising on personal matters that impact your academics. Other resources that you may find helpful are listed on the U of T Engineering Mental Health & Wellness webpage, and a small selection are also included here:

14.3.1 Accessibility Services & the On-Location Advisor

14.3.2 Graduate Engineering Council of Students' Mental Wellness Commission

14.3.3 Health & Wellness and the On-Location Health & Wellness Engineering Counsellor

14.3.4 Inclusion & Transition Advisor

14.3.5 U of T Engineering Learning Strategist and Academic Success

14.3.6 My Student Support Program (MySSP)

14.3.7 Registrars Office

14.3.8 SKULE Mental Wellness

14.3.9 Scholarships & Financial Aid Office & Advisor

If you find yourself, feeling distressed and in need of more immediate support resources, consider reaching out to the counsellors at My Student Support Program (MySSP) or visiting the Feeling Distressed webpage.