

**Western University
Faculty of Engineering
Department of Electrical and Computer Engineering**

ECE 2240a – Electrical Laboratory I

Course Outline for 2023 - 2024

Description:

This course provides students with hands-on experience that will enhance the concepts studied in the second-year courses on electrical circuits and familiarizes the student with the standard equipment in the undergraduate laboratories as well as circuit simulation software. At the end of this course, it is expected that each student will be able to operate the equipment and interpret the measurements and use a circuit simulation software package.

Academic Calendar Copy:

Laboratory experiments associated with [ECE 2205A/B](#), as well as laboratory experiments in instrumentation and measurement; the lecture component includes review of laboratory practice, health and safety issues, simulation software, data collecting methods; errors and their calculus; accuracy; averaging, signal conditioning, and data interpolation.

Contact Hours: 1 lecture hour/week, 1 tutorial hour/week, 9 Lab sessions (3 hours each)

Course Weight: 0.50

Restrictions: none

Prerequisite(s): [Computer Science 1026A/B](#) or [Engineering Science 1036A/B](#)

Corequisite(s): [ECE 2205A/B](#)

Unless you have either the requisites for this course or written special permission from your Dean to enrol in it, you will be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees if you are dropped from the course for failing to have the necessary prerequisites.

CEAB Academic Units: Engineering Science 85%, Engineering Design 15%

Course Material:

The laboratory exercises, supplementary material and relevant manuals of instruments and software will be posted to the course website. Course material is taught in course lectures, tutorials, and laboratory sessions. Therefore, it is imperative that students attend these.

For circuit simulation, students are required to use the Micro-Cap circuit simulation software and can be found of the OWL course site (for local installation) or alternatively available via *AppsAnywhere* cloud service in the Engineering Computer labs or for your personal Windows-based computer. This software will be needed in some of the laboratory exercises.

For PCB design, students are required to use the EAGLE software and a free evaluation copy can be downloaded from: www.autodesk.com.

The laboratory equipment and software used in the course require using a Windows PC or laptop. It is student's responsibility to assure hardware compatibility and proper drivers for other types of computer devices, using Apple iOS or other operating systems.

References:

1. David A. Bell, Electronic Instrumentation and Measurements, 2nd Edition, Prentice-Hall, 1994.
2. Joseph Carr, Elements of Electronic Instrumentation and Measurements, 3rd Edition, Prentice-Hall, 1996.
3. Albert D. Helfrick and William D. Cooper, Modern Electronic Instrumentation and Measurement Techniques, 2nd Edition, Prentice-Hall, 1990.
4. Larry D. Jones & A. Foster Chin, Electronic Instruments and Measurements, 2nd Edition, Prentice-Hall, 1991.
5. Alan S. Morris, Principles of Measurement and Instrumentation, 2nd Edition, Prentice-Hall, 1993.
6. J. David Irwin and R. Mark Nelms, Basic Engineering Circuit Analysis, 8th, 9th or 10th Edition, Wiley, 2011.

General Learning Objectives (CEAB Graduate Attributes)

Knowledge Base	I	Engineering Tools	I	Impact on Society	
Problem Analysis	I	Individual & Teamwork		Ethics and Equity	
Investigation	I	Communication	I	Economics and Project Mgmt.	
Design	I	Professionalism		Life-Long Learning	

Rating: **I** – The instructor will introduce the topic at the level required. It is not necessary for the student to have seen the material before. **D** – There may be a reminder or review, but the student is expected to have seen and been tested on the material before taking the course. **A** – It is expected that the student can apply the knowledge without prompting (e. g. no review).

Course Topics and Specific Learning Outcomes	CEAB Graduate Attributes Indicators
<p>1: Building circuits on a circuit board.</p> <p>At the end of this section, students will be able to:</p> <ul style="list-style-type: none"> a. Understand layout of circuit board b. Is able to build circuit on the circuit board without mistakes. <p>2: Measuring resistance, voltage and current using digital and analog multimeters.</p> <p>At the end of this section, students will be able to:</p> <ul style="list-style-type: none"> a. Connect a multimeter and select appropriate settings. b. Understands how to interpret measured values for both DC and AC signals <p>3: Assessing the errors in measurements and the effect of the input resistance of the instruments.</p> <p>At the end of this section, students will be able to:</p> <ul style="list-style-type: none"> a. Estimate effects of input resistance on measurement. b. Calculate input resistance of the instruments and its effects on measurement accuracy. <p>4: Using the MicroCap circuit simulation software.</p> <p>At the end of this section, students will be able to:</p> <ul style="list-style-type: none"> a. Build and edit parameters of the circuits in the Micro-Cap schematic simulator b. Set and run DC, AC and Transient Analysis of the simulated circuit <p>5: Measuring parameters of AC signal using laboratory function generator and digital oscilloscope.</p> <p>At the end of this section, students will be able to:</p> <ul style="list-style-type: none"> a. Connect function generator and oscilloscope and select appropriate settings. b. Understand operation and main functions of the function generator and oscilloscope and how to interpret measured values for both DC and AC signals 	<p>ET1, I1</p> <p>ET1</p> <p>ET1, KB3</p> <p>ET2, I3</p> <p>ET1, ET2</p>

6: Study the characteristics and operation of basics op-amp circuits.

At the end of this section, students will be able to:

- a. Calculate parameters and simulate in MicroCap non-inverting and inverting amplifiers and integrator circuit based on op-amp application. Build and edit parameters of the circuits in the Micro-Cap schematic simulator
- b. Build the circuits on the breadboard and measure their parameters.

7: Study the characteristics and operation of first- and second order circuits.

At the end of this section, students will be able to:

- a. Calculate parameters, simulate in MicroCap and investigate the natural and step response of an RC and RL circuits. Build the circuits on the breadboard and measure their parameters.
- b. Calculate parameters, simulate in MicroCap and investigate response of a second order RLC circuits. Build the circuits on the breadboard and measure their parameters.

8: Design an electrical circuit by given parameters, design a Printed Circuit Board using EAGLE software, solder and test the device, write a formal Report.

At the end of this section, students will be able to:

- a. Design and calculate component values of an electrical circuit, simulate it in MicroCap and verify the design. Build the circuit on the breadboard and measure its parameters.
- b. Design a Printed Circuit Board using EAGLE software, solder components and test the completed device.

KB3, ET1, ET2,
I2

KB3, ET1, ET2

ET1, ET2

D1, CS3

PA1, PA2,

I1, I2, I3

Course Evaluation:

Course Component	Weight
Laboratory Exercises (Lab#1 to Lab#7)	50%
Project (Lab#8)	20%
Final Examination	30%

To obtain a passing grade in the course, a student must complete and submit all eight lab exercises and achieve 50% or more on each of the three course components, Laboratory Exercises (Lab#1 to Lab#7), Project (Lab#8), and Final Examination. Failure to achieve this will result in a final course grade of 48% or less

Laboratory Exercises:

Seven laboratory experiments (Lab#1 to Lab#7) are planned for this course, each containing pre-lab, demonstrations to TA, and lab a report. Lab reports are due at the end of each lab session, unless

otherwise specified. No late submission of lab report is allowed without a special permission from the Course Instructor.

Project (Lab#8): Each student is required to design, build, and test an electrical circuit on a breadboard. Also, each student is required to design a Printed Circuit Board, solder, test, and demonstrate its functionality; then write a formal report. The details of the project will be distributed in class. The project is done over two lab sessions and a project report is due at the end of the second lab session. No late lab report submission is allowed without a special permission from the Course Instructor.

Laboratory Exercise Schedule:

Lab#1: Breadboards and DC	Week of Sept. 18 th
Lab#2: Microcap Circuit Simulation	Week of Sept 25 th
Lab#3: Errors in Measurement	Week of Oct. 2 nd
Lab#4: Oscilloscope and Function Generator	Week of Oct. 16 th
Lab#5: Composite Voltages	Week of Oct. 23 rd
Lab#6: Basic OPAMP Circuits	Week of Nov. 6 th
Lab#7: First-order Circuits	Week of Nov. 20 th
Lab#8: Project	Week of Nov. 13 th (Breadboard testing phase) Week of Nov. 27 th (PCB testing phase)

Final Examination:

The final examination will be closed book exam and three hours long. A calculator is allowed during the final examination. Date and time of exam will be announced by the Office of Registrar.

Use of English Policy: In accordance with Senate and Faculty Policy, students may be penalized up to 10% of the marks on all assignments, tests, and examinations for improper use of English. Additionally, poorly written work except for the final examination may be returned without grading. If resubmission of the work is permitted, it may be graded with marks deducted for poor English and/or late submission.

Attendance Policy: All classes, laboratories, and tutorials are mandatory unless otherwise stated and the attendance will be taken. Any student who, in the opinion of the instructor, is absent too frequently from class, laboratory, or tutorial periods will be reported to the Dean (after due warning has been given). On the recommendation of the department, and with the permission of the Dean, the student will be debarred from taking the regular final examination in the course.

Absence Due to Illness or Other Circumstances: Students should immediately consult with the instructor or department Chair if they have any problems that could affect their performance in the course. Where appropriate, the problems should be documented (see the attached "Instructions for Students Unable to Write Tests or Examinations or Submit Assignments as Scheduled"). The student should seek advice from the instructor or department Chair regarding how best to deal with the problem. Failure to notify the instructor or department Chair immediately (or as soon as possible thereafter) will have a negative effect on any appeal.

Missing the Lab section: Completing all labs in this course is mandatory. If a student misses a lab, it is student's responsibility to contact the ECE Department office and the Course Instructor at the first opportunity (but no later than one week) after the absence and present a valid original medical note and/or other documentations to prove reasons for absence.

The student will only be allowed to make up for a missed laboratory if he/she has a valid excuse (e.g., doctor's note, etc.) and has approval from Department office and the Course Instructor. Make up lab sessions are earmarked in the Laboratory Timetable.

For more information concerning medical accommodations, see the relevant section of the Academic Handbook:

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_medical.pdf

For more information concerning accommodations for religious holidays, see the relevant section of the Academic Handbook:

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_religious.pdf

Cheating and Plagiarism: Students must write their reports, essays and assignments in their own words. Whenever students take an idea or a passage from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. University policy states that cheating, including plagiarism, is a scholastic offence. The commission of a scholastic offence is attended by academic penalties, which might include expulsion from the program. If you are caught cheating, there will be no second warning.

All required papers may be subject to submission for textual similarity review to commercial plagiarism-detection software under license to the University for the detection of plagiarism. All papers submitted will be included as source documents on the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between the University of Western Ontario and Turnitin.com (<http://www.turnitin.com>).

Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, in the relevant section of the Academic Handbook:

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf

Use of Electronic Devices: Students may use laptops, tablet computers, or smart phones *only* to access the course OWL site during lectures and tutorials. Use of *nonprogrammable* calculators *only* is permitted during quizzes and examinations. No other electronic devices may be used at any time during lectures, tutorials, or examinations.

Policy on Repeating All Components of a Course: Students who are required to repeat an Engineering course must repeat all components of the course. No special permissions will be granted enabling a student to retain laboratory, assignment, or test marks from previous years. Previously completed assignments and laboratories cannot be resubmitted by the student for grading in subsequent years.

Internet and Electronic Mail: Students are responsible for regularly checking their Western e-mail and the course web site (<https://owl.uwo.ca/portal/>) and making themselves aware of any information that is posted about the course.

Accessibility: Please contact the course instructor if you require material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 519-661-2111 ext. 82147 for any specific question regarding an accommodation.

Support Services: Office of the Registrar, <http://www.registrar.uwo.ca/>

Student Development Centre, <http://www.sdc.uwo.ca/>

Engineering Undergraduate Services, <http://www.eng.uwo.ca/undergraduate/>

USC Student Support Services, <http://westernusc.ca/services/>

Students who are in emotional/mental distress should refer to Mental Health @ Western, http://www.health.uwo.ca/mental_health/, for a complete list of options about how to obtain help.

STATEMENT ON GENDER-BASED AND SEXUAL VIOLENCE

Western [is committed to reducing incidents of gender-based and sexual violence](#) and providing compassionate support to anyone who has gone through these traumatic events. If you have experienced gender-based or sexual violence (either recently or in the past), you will find information about support services for survivors, including emergency contacts, [here](#). To connect with a case manager or set up an appointment, please contact support@uwo.ca.

INSTRUCTIONS FOR STUDENTS UNABLE TO WRITE TESTS OR EXAMINATIONS OR SUBMIT ASSIGNMENTS AS SCHEDULED

If, on medical or compassionate grounds, you are unable to write term tests or final examinations or complete course work by the due date, you should follow the instructions listed below. You should understand that academic relief will not be granted automatically on request. You must demonstrate to your department (or the Undergraduate Services Office) that there are compelling medical or compassionate grounds that can be documented before academic relief will be considered. Different regulations apply to term tests, final examinations and late assignments. Please read the instructions carefully.

A. GENERAL REGULATIONS & PROCEDURES

1. All first-year students will report to the Undergraduate Services Office by submitting the [Academic Consideration Request Form](#), for all instances.
2. If you are an upper year student and you are missing a test/assignment/lab or examination you will report the absence by submitting [Academic Consideration Request Form](#). Absences worth LESS THAN 10% of your mark, will be processed by your department office. If your course work is worth 10% OR MORE of your final grade, your request will be processed by the Undergraduate Services Office.
3. Check the course outline to see if the instructor has a policy for missed tests, examinations, late assignments or attendance.
4. Documentation must be provided as soon as possible. If no one is available in your department office or the Undergraduate Services Office, leave a message clearly stating your name & student number and reason for your call. The department telephone numbers are given at the end of these instructions.
5. If you decide to write a test or an examination you should be prepared to accept the mark you earn. Rewriting tests or examinations or having the value of a test or examination reweighted on a retroactive basis is not permitted.

B. TERM/MIDTERM TESTS

1. If you are in first year and you are unable to write a midterm/term test, contact the Undergraduate Services Office, SEB 2097 PRIOR to the scheduled date of the test.
2. If you are an upper year student and you are unable to write a midterm/term test, inform your instructor PRIOR to the scheduled date of the test and request relief through the [Academic Consideration Request Form](#). If the instructor is not available, leave a message for him/her at the department office. If the test is worth LESS THAN 10% of your mark, your request for relief will be processed by your department office. If the test is worth MORE THAN 10% of your final grade your request for relief will be processed by the Undergraduate Services Office.
3. Be prepared to attach supporting documentation to the Department Chair and/or the Undergraduate Services Office through the online form (see next page for information on documentation).
4. Discuss with the instructor if and when the test can be rescheduled. The approval of the Chair or the Undergraduate Services Office is required when rescheduling midterm/term tests.

C. FINAL EXAMINATIONS

1. If you are unable to write a final examination, contact the Undergraduate Services Office PRIOR TO THE SCHEDULED EXAMINATION TIME to report your absence using the [Academic Consideration Request Form](#) and request permission to write a Special Final Examination. If no one is available in the Undergraduate Services Office, leave a message clearly stating your name & student number.
2. Be prepared to provide the Undergraduate Services Office with supporting documentation (see next page for information on documentation) the next day, or as soon as possible (in cases where students are hospitalized). The following circumstances are not considered grounds for missing a final examination or requesting special examinations: common cold, headache, sleeping in, misreading timetable and travel arrangements.
3. In order to receive permission to write a Special Examination, you must obtain the approval of the Chair of the Department **and** the Associate Dean and in order to apply you must submit an "[Application for a Special Exam](#)" form. The Undergraduate Services Office will then notify the course instructor(s) and reschedule the examination on your behalf.

PLEASE NOTE: It is the student's responsibility to check the date, time and location of the Special Examination.

D. LATE ASSIGNMENTS

1. Advise the instructor if you are having problems completing the assignment on time (**prior** to the due date of the assignment).
2. Be prepared to submit the [Academic Consideration Request Form](#) and provide documentation if requested by the instructor (see reverse side for information on documentation).
3. If you are granted an extension, establish a due date. The approval of the Chair of your Department (or the Assistant Dean, First Year Studies, if you are in first year) is not required if assignments will be completed prior to the last day of classes.
4.
 - i) Extensions beyond the end of classes must have the consent of the instructor, the department Chair and the Associate Dean, Undergraduate Studies. Documentation is mandatory.
 - ii) A Recommendation of Incomplete Form must be filled out indicating the work to be completed and the date by which it is due. This form must be signed by the student, the instructor, the department Chair and the Associate Dean, Undergraduate Studies.

E. SHORT ABSENCES

If you miss a class due to a minor illness or other problem, check your course outlines for information regarding attendance requirements and make sure you are not missing a test, laboratory or assignment. Cover any readings and arrange to borrow notes from a classmate.

F. EXTENDED ABSENCES

If you are absent more than one week or if you get too far behind to catch up, you should consider reducing your workload by dropping one or more courses. (Note drop deadlines listed below). You are strongly encouraged to seek advice from your Academic Counsellor in the Undergraduate Services Office.

G. DOCUMENTATION

If you consulted an off-campus doctor or Student Health Services regarding your illness or personal problem, **you must provide the doctor with a Student Medical Certificate** to complete at the time of your visit and then bring it to the Department (or the Undergraduate Services Office). **This note must contain the following information: severity of illness, effect on academic studies and duration of absence. Regular doctor's notes will not be accepted; only the Student Medical Certificate will be accepted.**

In Case of Serious Illness of a Family Member: Provide a Student Medical Certificate to your family member's physician to complete and bring it to the Department (or the Undergraduate Services Office if you are in first year).

In Case of a Death: Obtain a copy of the death certificate or the notice provided by the funeral director's office. You must include your relationship to the deceased and bring it to the Department (or the Undergraduate Services Office if you are in first year).

For Other Extenuating Circumstances: If you are not sure what documentation to provide, ask the Departmental Office (or the Undergraduate Services Office if you are in first year) for direction.

Note: Forged notes and certificates will be dealt with severely. To submit a forged document is a scholastic offence (see below).

H. ACADEMIC CONCERNS

1. You need to know if your instructors have a policy on late penalties, missed tests, etc. This information may be included on the course outlines. If not, ask your instructor(s).
2. **You should also be aware of attendance requirements in some courses. You can be debarred from writing the final examination if your attendance is not satisfactory.**
3. If you are in academic difficulty, check out the minimum requirements for progression in the calendar. If in doubt, see your Academic Counsellor.

Calendar References: Check these regulations in your 2023 Western Academic Calendar available at www.westerncalendar.uwo.ca.

Absences Due to Illness:

https://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_13_5

Academic Accommodations for Students with Disabilities:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_10

Academic Accommodations for Religious or Holy Days:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_16

Course Withdrawals:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=6&SelectedCalendar=Live&ArchiveID=#Page_75

Examinations:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?PolicyCategoryID=5&command=showCategory&SelectedCalendar=Live&ArchiveID=#Page_78

Scheduling of Term Assignments:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=5&SelectedCalendar=Live&ArchiveID=#SubHeading_78

Scholastic Offences:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_20

Student Medical Certificate:

<https://www.eng.uwo.ca/files/undergraduate/student-medical-certificate.pdf>

Engineering Academic Regulations:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=4&SelectedCalendar=Live&ArchiveID=#Page_86

Note: These instructions apply to all students registered in the Faculty of Engineering regardless of whether the courses are offered by the Faculty of Engineering or other faculties in the University.

<u>Add Deadlines:</u>	First term half course (i.e. “A” or “F”)	September 15, 2023
	Full courses and full-year half course (i.e. “E”, “Y” or no suffix)	September 15, 2023
	Second term half course (i.e. “B” or “G”)	January 16, 2024

<u>Drop Deadlines:</u>	First term half course without penalty (i.e. “A” or “F”)	November 13, 2023
	Full courses and full-year half courses without penalty (i.e. “E”, “Y” or no suffix)	November 30, 2023
	Second term half or second term full course without penalty (i.e. “B” or “G”)	March 7, 2024

Contact Information:

Undergraduate Services Office:	SEB 2097	Phone: 519-661-2130	E-mail: engugrad@uwo.ca
Chemical & Green Process Engineering:	TEB 477	Phone: 519-661-2131	E-mail: cbeugrad@uwo.ca
Civil Engineering:	SEB 3005	Phone: 519-661-2139	E-mail: civil@uwo.ca
Computer, Electrical, Mechatronic Systems & Software Engineering	TEB 279	Phone: 519-661-3758	E-mail: eceugrad@uwo.ca
Integrated Engineering	ACEB 2410	Phone: 519-661-6725	E-mail: engceli@uwo.ca
Mechanical Engineering:	SEB 3002	Phone: 519-661-4122	E-mail: mmeundergraduate@uwo.ca