

**Western University
Faculty of Engineering
Mechatronic Systems Engineering Program**

MSE 2201 – Introduction to Electrical Instrumentation

Course Outline Fall/Winter 2025

COURSE DESCRIPTION: This course is primarily a laboratory course that uses lecture material to support experimental investigations. It therefore provides the students with hands-on experience in electric circuits and instrumentation. Students registered in MSE2201A/B must simultaneously register in the concurrent course ECE2205A/B, which provides the required theoretical background in analysis and design of linear electric circuits. This course provides hands-on investigation of the linear electric circuits discussed in ECE2205A/B but also introduces non-linear electronic components (such as diodes and transistors), sensors (photoresistors, thermistors, phototransistors), and motors and actuators. This course is restricted to students enrolled in the Mechatronic Systems Engineering program.

ACADEMIC CALENDAR:

https://www.westerncalendar.uwo.ca/Courses.cfm?CourseAcadCalendarID=MAIN_023635_1&SelectedCalendar=Live&ArchiveID=

Introduction to instrumentation and basic electronics; Laboratory experiments associated with ECE2205A/B, as well as laboratory experiments in instrumentation and measurement; review of laboratory practice, health and safety issues, simulation software, data collecting methods; errors and their calculus; accuracy; averaging, signal conditioning, and data interpolation.

PRE OR COREQUISITES: ECE2205A/B (Corequisite). Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you will be removed from this course and it will be deleted from your record.

ANTIREQUISITES: ECE2240A/B

CEAB ACADEMIC UNITS: Engineering Science 100%, Engineering Design 0%

CONTACT HOURS:

Lectures occur weekly Laboratory sessions occur weekly.

LECTURE:	3 hours/week
LAB:	3 hrs, 11 sessions per term: eight 3-hour lab exercises, two 3-hour project exercises, and one 1-hour lab examination in total.
TUTORIAL:	None.

RECOMMENDED/REQUIRED TEXT: No required textbook. Instructor's course notes and sample problems, distributed on OWL, should be sufficient.

Allen R. Hambley, *Electrical Engineering: Principles and Applications*, 7th Ed. (or later), Pearson (2018) is a good reference text for the material covered in this course, but it is not necessary.

RECOMMENDED/ REQUIRED SOFTWARE: Altium Designer or LTSpice are required to perform the circuit simulations necessary to complete the laboratory exercises. Altium Designer offers free student licenses and LTSpice is free. Altium Designer is recommended, but it only runs natively on Windows. LTSpice is available for Windows and MacOS. Either software program will work equally well for this course, but other courses in the program are expected to transition to using Altium Designer.

RECOMMENDED RESOURCES/REFERENCES: Students must purchase a laboratory kit from the Electronics Shop. The cost is \$125. See below for more information.

GENERAL LEARNING OBJECTIVES (CEAB GRADUATE ATTRIBUTES)

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

Notation: x represents the content level code as defined by the CEAB. blank = not applicable; I = introduced (introductory); D = developed (intermediate) and A = applied (advanced).

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 MATERIALS: Weekly content and guides for the laboratories will be available on the course OWL site. The material for this course will be taught in both lectures and labs; therefore, it is imperative that you attend each lecture and lab.

UNITS: SI

COURSE TOPICS AND SPECIFIC LEARNING OUTCOMES: This course covers a broad range of circuit components in the context of prototyping practical circuitry for mechatronic designs. This course introduces circuit simulation, construction, and characterization techniques that will be essential in later mechatronics systems engineering courses.

The following table summarizes the course learning outcomes along with CEAB GAls where the GAls in bold indicate ones to be measured and reported annually.

Course Topics and Specific Learning Outcomes	CEAB Graduate Attribute Indicators
Circuit Construction and Components At the end of this section, students will be able to: a. Understand and draw circuit diagrams.	KB3, ET2

b. Recognize and understand circuit symbols and the principal elements of electric circuits. c. Construct circuits on a breadboard. d. Identify resistors, capacitors, and inductors based on the colour-coding and labelling of the component. e. Understand dual voltage power supplies and function generators, and how to use them in circuits.	
Circuit Characterization and Sources of Error At the end of this section, students will be able to: a. Understand multimeters and oscilloscopes, and how to use them to characterize circuits. b. Understand sources of error in circuit characterization. c. Understand the propagation of errors in calculations based on measured values.	KB3, ET2
Validation of Linear Circuit Theory At the end of this section, students will be able to: a. Construct and characterize basic linear circuits. b. Use measurements to validate physical laws such as Ohm's Law, Kirchoff's circuit laws, first- and second-order transient response, and steady-state AC behaviour. (The theory behind these linear circuits is taught in ECE2205, taken in parallel with this course.)	KB3, I2, I3
Circuit Design and Simulation Tools At the end of this section, students will be able to: a. Design circuits using appropriate circuit simulation software. b. Simulate the transient response, DC properties, and AC properties of circuits using circuit simulation software.	KB3, I2, I3, ET2
Sensors At the end of this section, students will be able to: a. Understand the fundamentals of simple electro-mechanical, optical, and thermal sensors. b. Apply engineering principles to interpret data from encoders, thermistors, and phototransistors.	KB3
Diode Circuits At the end of this section, students will be able to: a. Understand the basic principles of diodes. b. Use various circuit models of diodes to analyze and design simple circuits.	KB3, I2, I3
Transistor Circuits At the end of this section, students will be able to: a. Understand the similarities and differences between BJTs and FETs. b. Use simple models of BJTs and FETs to analyze simple circuits. c. Understand how transistors can be used as switches and design basic transistor circuits.	KB3, I2, I3
Operational Amplifiers At the end of this section, students will be able to: a. Understand the properties of ideal amplifiers. b. Analyze and design basic op-amp circuits.	KB3
Motors and Control Circuits	KB3, I2, I3

At the end of this section, students will be able to:	
a. Identify actuators, including DC motors. b. Analyze and design basic DC motor control circuits. c. Understand and construct PWM circuits for driving DC motors. d. Design and build a servo motor driver.	

EVALUATION:

Name	% Worth	Assigned	Due Date	CEAB GAs ASSESSED
Laboratory Experiments (8 Total)	40%			KB3, I2, I3
Laboratory Examination	10%			KB3, ET2, I2, I3
Project	10%			ET2, I2, I3
Final Examination	40%			KB3

Note that the dates listed above are **tentative** and may be adjusted if needed. Marks will be assigned on the basis of method of analysis and presentation, correctness of solution, clarity and neatness.

COURSE POLICIES:

All work submitted must be of professional quality in the requested format. Material that is handed in dirty, illegible, disorganized, or in an unapproved format will be returned to the student for resubmission and the late submission penalty will take effect. An additional penalty of 10% may be deducted for poor grammar, incoherence, or lack of flow in the written reports.

Some components of course work require supplementing written work with data or graphs of measurements or simulations. Exporting these from their native programs as an image is the best approach, taking a screen capture is also acceptable. It is **not acceptable to take a photograph of a computer screen with your phone** (or any other device). It is acceptable to take a photograph of the benchtop digital oscilloscope screen.

Laboratory: Eight lab experiments are to be performed in this course. During the laboratory students shall work individually. Each exercise is to be completed within the three-hour lab period. Most lab exercises involve some preliminary calculations; these must be completed **before** attending the lab session and proof of completion must be shown to the TAs before the student will be admitted to the lab session.

Individual laboratory reports are required and to be submitted on OWL. Most of these reports are simple and can be completed during the lab session. Submitting these reports online is worth a token grade and is mostly

for maintaining course records. Two lab reports involve more complicated analysis that may need to be done outside of the lab session. These reports will also be graded in detail, and these lab exercises are worth double weight.

Students who miss a laboratory session must make up that exercise at a future date. Any student who misses a laboratory session should contact the course instructor to explain the situation and work out an alternate time for completing the lab exercise. If that student is unable to complete the laboratory session and does not have a legitimate reason (for example, academic accommodation due to prolonged medical absence, etc.), they will receive a score of zero for that particular lab. Students who miss two or more laboratory sessions, are unable to make them up before the end of the course, and do not have a legitimate reason will fail the course and receive a final grade of 48% or less. Students whose average score on all eight laboratory exercises is less than 50% will fail the course and receive a final grade of 48% or less.

Project: Each student will be required to design, build, and test an electric circuit on a breadboard and write a report. The details of the design requirements for this electric circuit will be distributed in class, at least two weeks before the report is due. The grade for the project will be derived from the in-person demonstration of the working circuit during the regular laboratory schedule and the written report submitted to OWL. The last two laboratory sessions in the course are for developing and demonstrating the project.

Laboratory Examination: There will be an in-person, in-lab examination that essentially serves as a midterm exam for this course. Students will be admitted to the lab in small groups, and each student will be presented with a unique circuit to build, characterize, and demonstrate to the TAs. Students **may not use a self-reported absence** for this assessment. This will be a closed-book exercise under normal examination conditions: students may not use laptops, cell phones, give or accept aid from others, etc.

If students are granted academic accommodation for missing the laboratory examination, their examination will be rescheduled to a suitable lab session as arranged between the student and the course instructor.

Students must complete this laboratory exam. As it is unlike the regular lab exercises and the written final examination, it is not appropriate to use other course assessments to account for the laboratory exam grade.

Laboratory Kit: Students must purchase a lab kit from the Electronics Shop. This kit includes a device that acts as dual-channel digital oscilloscope, digital multimeter, and function generator. This device will be used in future MSE courses. The kit also includes various circuit components that can be used to complete the laboratory exercises and the project. This kit costs \$125 and can be purchased from Wester Engineering eStores.

The first few lab exercises can be completed without the lab kit, but students should purchase the lab kit as early as possible. It will not be possible to complete all the lab exercises without purchasing the lab kit.

Final Examination: The final examination will take place during the regular examination period. The final examination will be an **in-person, closed-book**, written exam. A non-programmable calculator may be used, but use of any other electronic device is not permitted during the examination.

To obtain a passing grade in the course, a mark of 50% or more must be achieved on the final examination. A final examination mark < 50% will result in a final course grade of 48% or less.

If the above conditions are not met, your final grade cannot be greater than 48%. Students who have failed this course (i.e., final average < 50%) must repeat all components of the course.

LATE SUBMISSION POLICY:

This course employs flexible deadlines for laboratory and project reports. The report deadlines will be posted on OWL well in advance of the due date. For each report, students are expected to submit the report by the deadline listed. Should illness or extenuating circumstances arise, students are permitted to submit their report up to 48 hours past the deadline without academic penalty. Late reports will not be accepted without permission from the course instructor. Should students miss the flexible deadline, they should contact the course instructor by email to resolve the situation. **As flexible deadlines are used in this course, requests for academic consideration will not be granted.**

If you have a long-term academic consideration or accommodation for disability that allows greater flexibility than provided here, please reach out to your instructor at least one week prior to the posted deadline.

ATTENDANCE: Attendance is mandatory for all lab sessions.

FACULTY OF ENGINEERING POLICIES:

Students must familiarize themselves with the policies of the Faculty of Engineering, available at:

<https://www.eng.uwo.ca/electrical//pdf/2025-UG-Policy-and-Procedures.pdf>

These policies (dated to September 2025) are also available on the subsequent pages of this document.