Western University
Faculty of Engineering
Department of Electrical and Computer Engineering

ECE 2238B: Introduction to Electrical Engineering

Course Outline 2023-2024

Description: Analysis and simplification of dc/ac circuits containing resistors, capacitors, inductors, dependent/independent sources, diodes, transistors, and operational amplifiers using fundamental laws, network theorems and mesh/node analysis are introduced. Semiconductor physics, charge carriers, energy levels, and bandstructures in materials. Models of electrical conductivity in solids. Introductory quantum mechanics relevant to understanding spintronics and rudimentary quantum computing. The behavior of linear circuits in frequency-domain is also studied. At the end of the course, students will be able to understand and analyze commonly used electrical and electronic circuits and systems.

Academic Calendar Copy: DC circuit analysis, fundamentals of DC circuit analysis, Ohm's Law, KCL, KVL, Thévenin and Norton Equivalent circuits, maximum power transfer; linear analog circuits, diodes, transistors, operational amplifiers, biasing, gain, frequency response.

Contact Hours: 3 lecture hours per week, 1 laboratory hours per week (four 3-hour exercises per term), 1 tutorial hours per week (eight 1-hour sessions per term), 0.5 course.

Antirequisite: ECE2205A/B, ECE2231A/B.

Prerequisites: ES1036A/B or CS1026A/B, Physics 1302A/B or Physics 1402A/B

Pre- or Co-requisite: NMM2270A/B or former Applied Mathematics 2270A/B

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. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

CEAB Academic Units: Engineering Science 50%, Natural Science 50%.

Required Textbook: Allan R. Hambley, *Electrical Engineering Principles and Applications*, Pearson, Prentice Hall, 7th Edition (or later).

Other Required References: Extensive lecture notes will be provided as PDFs and distributed over OWL.

Recommended References: None.

General Learning Objectives (CEAB Graduate Attributes)

Knowledge Base	I	Use of Engineering Tools		Impact on Society and the Environment	
Problem Analysis	I	Individual and Team Work		Ethics and Equity	
Investigation		Communication Skills		Economics and Project Management	I
Design		Professionalism		Life-Long Learning	

Notation*: where x be I: Introductory, D: Intermediate, A: Advanced, or empty*. 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**
1. Basic Electrical Quantities and Simple Resistive Circuits:	
At the end of this section, students will be able to:	
a. Define basic electrical quantities such as voltage, current, power, and energy, including their units.	**KB4**
b. State and apply Ohm's and Kirchoff's current and voltage laws.	**KB4, PA2**
c. Solve for currents, voltages, and powers in simple resistive circuits.	**PA2**
d. Simplification of resistive circuits by combining resistances in series and parallel.	**PA3**
2. Inductors and Capacitors	
At the end of this section, students will be able to:	
a. Describe the typical physical construction of capacitors and inductors.	**KB2, KB4**
b. Determine current and voltage in dc electric circuits containing capacitors and inductors.	**PA1**
c. Calculate the amount of energy stored in capacitors and inductors.	**PA2**
3. Node and Loop Analysis Techniques	
At the end of this section, students will be able to:	
a. Define nodes and meshes in an electric circuit.	**KB4, PA1**
b. Solve resistive circuits for currents and voltages using the node-voltage technique.	**KB4, PA2, PA3**
c. Solve resistive circuits for currents and voltages using the mesh-current technique.	**KB4, PA2, PA3**
4. Semiconductor Physics	
At the end of this section, students will be able to:	

a. Understand classical and semiclassical models of electrical conductivity in solids.	**KB2**
b. Understand the meaning of electronic bandstructure.	**KB2**
c. Qualitatively predict material properties based on electronic bandstructure diagrams.	**KB2**
d. Understand the properties of intrinsic and doped semiconductors.	**KB2**
5. Fundamentals of Diodes and Transistors	
At the end of this section, students will be able to:	
a. Understand the operation of diodes and select diodes for various applications.	**KB4**
b. Understand the operation of a transistor and use its circuit model to design simple analog amplifiers.	**KB4**
c. Understand the importance of transistors in digital circuit and design simple CMOS logic gates.	**KB4**
6. Fundamentals of Operational Amplifiers	
At the end of this section, students will be able to:	
a. Understand the circuit model of an operational amplifier.	**KB4**
b. Design circuits using operational amplifier to perform basic arithmetic operations such as addition, subtraction, and multiplication.	**PA2**
c. Design differentiators and integrators using operational amplifiers, resistors, capacitors, and inductors.	**PA3**
7. Introduction to Quantum Mechanics	
At the end of this section, students will be able to:	
a. Understand the failings of classical mechanics.	**KB4**
b. Understand simple models of the atom.	**PA2**
c. Qualitatively predict chemical properties of solids based on atomic composition.	**PA1**
8. The Problem of Measurement	
At the end of this section, students will be able to:	
a. Understand the concept of measurements in quantum mechanics and wavefunction collapse.	**KB2**
b. Understand superposition and entanglement.	**KB2**
c. Understand the basic principles of quantum computation.	**KB2**
9. Hardware/Software Design Considerations	
At the end of this section, students will be able to:	
a. Compare and contrast hardware and software methods for signal processing.	**EPM1**

Evaluation

Course Component	Weight
Homework Assignments	20%
Laboratory	20%
Midterm Test	10%
Final Examination	50%

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

Homework Assignments: Assignments will be regularly announced and posted on the course OWL site. Students must provide their answers on OWL as instructed on the assignment and by the posted due date. These assignments will be problem based.

Laboratory: This course has four lab exercises, with the laboratory mark is evenly distributed among them. Students are required to complete these exercises and submit their work to the TA for evaluation at the end of each laboratory session. The lab schedule and lab manuals will be available on OWL.

Midterm Test: The midterm test will be scheduled during the regular academic term; the exact date will be determined later. Students will be notified of the test date through the course OWL site with no less than 2 weeks of advance notice. The midterm test is **optional**, if students do not complete the midterm, that portion of their grade will be added to the final examination.

Final Examination: The final examination will take place during the regular examination period, as scheduled by the registrar. The final examination will cover all content discussed in the lessons. If a student receives a higher grade on their final exam then on their midterm exam, the midterm grade will be discarded, and the final exam grade will be used in its stead.

Late Submission Policy: Homework Assignments should be submitted by the posted deadlines. Accommodations for late submission might be made at student's request (assuming this request is made in a timely manner) at the instructor's discretion. The priority will be marking submitted assignments and posting the answers to OWL reasonably promptly after the assignment deadline as a study aid for students. No late assignments will be accepted, for any reason, after the answers are posted. Students should complete laboratory exercises according to the posted schedule. Students must contact the instructor promptly if they are unable to meet a laboratory submission deadline and seek an accommodation. Laboratory assignments will generally not be accepted after the posted deadline unless an accommodation is granted for exceptional circumstances.

Assignment Submission Locker: Submission of any and all course work (homework, lab reports) will be done online using OWL. A submission locker will not be used.

Academic Consideration: Students who require academic consideration due to medical or personal reasons should alert the instructor of their situation as soon as possible. As all homework assignments and laboratory reports can be completed over an extended period, academic consideration is generally **only** grounds for an extension on submitting that assessment, **not** an excuse for failing to complete that assessment. In particular, **each laboratory exercise must be completed,** or the student will receive 0% for that exercise. Students with academic consideration

can have their lab session rescheduled, but under no circumstances will their grade for that lab exercise be waived. Students under exceptional circumstances (i.e. prolonged leave of absence) may qualify for having the grade of individual homework assessments redistributed or use their final exam grade instead; these will be assessed at the instructor's discretion based on circumstance.

Use of English: 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 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: 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. Attendance may be assessed by the frequency of that student's access to OWL.

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.

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

Missed Midterm Examinations: If a student misses a midterm examination, she or he must follow the Instructions for Students Unable to Write Tests and provide documentation to Undergraduate Services Office within 24 hours of the missed test. If accommodation is granted, the department will provide a make-up test.

If a student is going to miss the midterm examination for religious reasons, they must inform the instructor in writing within 48 hours of the announcement of the exam date or they will be required to write the exam.

Since the midterm is optional, any student who misses the midterm and does not provide a request for accommodation will have that portion of their grade automatically reweighted towards the final exam.

Cheating and Plagiarism: Students must write their 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: Not applicable.

Use of Personal Response Devices ("Clickers"): Not applicable.

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 website (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.