Western University
Faculty of Engineering
Department of Electrical and Computer Engineering

ECE 2233B/MSE 2233B: Circuits and Systems

Course Outline 2023-24

January 8 to April 8, 2024

Description:
This course is intended to extend the concepts of direct current (DC) circuits discussed in ECE 2205a/b to alternating current (AC) circuits. In addition, in this course Laplace- and Fourier-techniques are introduced for understanding behavior of ac circuits in both time- and frequency-domains. Also, the concept of circuit as a system is introduced so that system-level ideas can be used for electrical circuit analysis.

Consultation hours:
Contact the instructor for an appointment using your UWO e-mail ID. All e-mail correspondence to the instructor and Teaching Assistants should bear the Subject as ECE 2233 or MSE 2233.

Academic Calendar Copy:

ECE 2233A/B
Introduction to a system level analysis of electrical circuits. The S-Plane and frequency response of circuits, frequency selective circuits, state variables, introduction to Fourier analysis, Fourier transform and Laplace transform techniques. Transfer functions and system functions.
Antirequisite(s)
Antirequisite(s): MSE 2233A/B.
Pre or Corequisites
Prerequisite(s): NMM 2270A/B or the former Applied Mathematics 2270A/B, ECE 2205A/B. **Corequisite(s):** NMM 2276A/B.
Extra Information
Extra Information: 3 lecture hours, 1 tutorial hour, 1 laboratory hour.
Course Weight: 0.50
Contact Hours: 3 lecture hours/week, 2 tutorial hours/week (6 tutorials per term), 3 laboratory hours/week (4 labs per term)
MSE 2233A/B
Introduction to a system level analysis of electrical circuits. The S-Plane and frequency response of circuits, frequency selective circuits, state variables, introduction to Fourier analysis, Fourier transform, and Laplace transform techniques. Transfer functions and system functions.
Antirequisite(s)
Antirequisite(s): ECE 2233A/B.

Pre or Corequisites
Prerequisite(s): NMM 2270A/B or the former Applied Mathematics 2270A/B, ECE 2205A/B.
Pre-or Corequisite(s): NMM 2276A/B or the former Applied Mathematics 2276A/B.
Extra Information
Extra Information: 3 lecture hours, 2 tutorial hours, 1 laboratory hour. Restricted to students enrolled in the Mechatronic Systems Engineering program or in Computer Engineering Option B.
Course Weight: 0.50
Contact Hours: 3 lecture hours/week, 2 tutorial hours/week (6 tutorials per term), 3 laboratory hours/week (4 labs per term)
Unless you have either the requisites for this course or written special permission from the 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 the course for failing to have the necessary prerequisites.
CEAB Academic Units: Engineering Science 100%.
Textbook:
J.D. Irwin and R.M. Nelms, Basic Engineering Circuit Analysis, 11th Edition, 2015, John Wiley & Sons, ISBN 978-1-118-53929-3. Any older or newer editions of the book will be fine too.

General Learning Objectives (CEAB Graduate Attributes)

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

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. AC Steady-State Analysis At the end of this section, students will be able to:	
a. Describe the basic characteristics of sinusoidal function and perform phasor and inverse phasor transformations and draw phasor diagrams	KB3
b. Understand and calculate impedance and admittance for basic circuit elements and determine equivalent impedance/admittance of circuit elements connected in series and parallel	KB3, PA2
c. Redraw time-domain circuit in frequency-domain given circuit with sinusoidal source and solve for currents and voltages in ac circuits	PA2
d. Apply various circuit analysis techniques to frequency-domain circuits to find currents and voltages in ac circuits	PA3

2.	**Steady-State Power Analysis in AC Circuits** At the end of this section, students will be able to:	
a.	Understand and calculate effective or rms value of periodic waveform and analyze a circuit to determine the instantaneous and average power in ac circuits.	KB3, PA1
b.	Understand and compute the real power, reactive power, complex power, and power factor in ac circuits.	KB3, PA2
c.	Modify a circuit to correct power factor in ac circuits.	PA2
3.	**Variable-Frequency Networks and Resonance of a Circuit** At the end of this section, students will be able to:	
a.	Understand the performance at any frequency of basic circuit elements R, L, and C	KB3
b.	Understand different types of network functions and the definition of poles and zeros. Also, learn to sketch Bode plot for a network function	KB3
c.	Understand the phenomenon of resonance in circuits and analyze series and parallel resonant circuits	KB3
4.	**The Laplace Transform** At the end of this section, students will be able to:	
a.	Understand and determine Laplace transform of signals commonly found in electric circuits	KB3
b.	Perform the inverse Laplace transform using partial fraction expansion Also, understand the concept of convolution	PA1
c.	Use the Laplace transform to analyze transient circuits	PA2
5.	**Transfer Function of Circuits** At the end of this section, students will be able to:	
a.	Understand the s-domain representation of basic circuit elements and construct s-domain representation of electric circuits	KB3
b.	Apply circuit analysis techniques to solve for voltages and currents in an s-domain circuit and use inverse Laplace transform to determine voltage and currents in time-domain	PA2
c.	Determine the transfer function for s-domain circuits and calculate a circuit's response to a unit step function and impulse function using a transfer function	PA2
6.	**Fourier Analysis of AC Circuits** At the end of this section, students will be able to:	
a.	Understand the trigonometric and exponential Fourier series for a periodic signal	KB3
b.	Calculate the steady-state response of an electric circuit when excited by a periodic voltage or current signal.	PA2
c.	Use the Fourier transform to calculate the response of an electric circuit. Also, apply Parseval's theorem to compute the total energy content of a signal	PA1
7.	**Two-port Network Analysis** At the end of this section, students will be able to:	

a. Understand how circuits or systems are described using two-ports and the parameters that describe them.	KB3
b. Understand and calculate Z-, Y-, and H-parameters of two-port networks. Also, understand ABCD or transmission parameters of two-port networks	KB3
c. Understand the various ways two-port networks are connected	KB3

Course Evaluation:

Course Component	Weight
Laboratory Exercise (4)	20%
Midterm Test (2 hours)	30%
Final Examination (3 hours)	50%

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

In accordance with the policy of the University, the grade assigned to all written and oral work presented in English shall take into account syntax, diction, grammar and spelling. In the professional life of an engineer, the manner in which oral and written communications are presented is extremely important. An engineering student must develop these skills as an integral part of the undergraduate program. To encourage the student to do so, the grades assigned to all written and oral work will take into account all aspects of presentation including conciseness, organization, neatness, use of headings, and the preparation and use of tables and figures and correctness of final answers in solutons. All work will be marked first for content after which a penalty not to exceed the maximum shown above would be applied.

Midterm Test: Date/Time: February 28, 2024, 12.30 to 2.30 PM, duration: 2 hours, format: closed book and written response required. Instructions for midterm test would be posted on the course website well in advance of midterm.

Final Examination: Date/Time: announced by the Registrar's office; will take place during the regular examination period, duration: 3 hours, format: closed book and written response required. Instructions for the final examination would be posted on the course website well in advance of the final examination.

Tutorials:

Tutorials are conducted by Teaching Assistants and timetable for tutorials would be posted on the course website.

Recording Online Activities: All remote learning sessions for this course will be recorded. The data captured during these recordings may include your image, voice recordings, chat logs and personal identifiers (name displayed on the screen). The recordings will be used for educational purposes related to this course, including evaluations. The recordings may be disclosed to other individuals participating in the course for their private or group study purposes. Please contact the instructor if you have any concerns related to session recordings. Participants in this course are not permitted to record the sessions, except where recording is an approved accommodation, or the participant has the prior written permission of the instructor.

Laboratory Exercises and Submission Policy:

a) All laboratory classes are conducted via ZOOM by Teaching Assistants. Circuit simulation software Micro-Cap 12 will be used for all laboratory exercises.

b) All completed laboratory exercises must be submitted on the due dates using the **Assignments Portal** on the course website for evaluation.
c) Completed laboratory exercises are due by 4.30 PM on due dates. Late submissions are not accepted as ample time is provided for completion of each laboratory exercise.

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.

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 accommodation, 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, seethe 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 the midterm examination, she or he must follow the Instructions for Students Unable to Write Tests and provide documentation to the Undergraduate Services Office within 24 hours of the missed test. If accommodation is granted, the department will decide whether to provide a make-up test or allow reweighting of the test, where reweighting means the marks normally allotted for the midterm will be added to the final exam. If no reasonable justification for missing the test can be found, then the student will receive a mark of zero for the midterm.

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 take the 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:

Use of Personal Response Devices ("Clickers"):

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 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.