ELEC 221 – ELECTRIC CIRCUITS

Course Syllabus – Fall 2025

This is your course syllabus. Please download the file and keep it for future reference.

LAND ACKNOWLEDGEMENT

Queen's University is situated on traditional Anishinaabe and Haudenosaunee Territory.
See: http://www.queensu.ca/encyclopedia/t/traditional-territories

INCLUSIVITY STATEMENT

Queen's students, faculty, and staff come from every imaginable background – small towns and suburbs, urban high rises, Indigenous communities, and from more than 100 countries around the world. You belong here: https://www.queensu.ca/inclusive/.

TEACHING TEAM

COURSE INSTRUCTOR

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ONQ ADMIN

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TUTORIAL TEACHING ASSISTANTS

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LAB TEACHING ASSISTANTS

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CLASS REPRESENTATIVES

Sec. 001: TBD
Sec. 002: TBD

ELEC 221 (F 3-0.75-0.5 4.25)

Course Description

This course introduces the circuit analysis techniques which are used in subsequent courses in electronics, power, and signals and systems. Circuits containing resistance, capacitance, inductance, and independent and dependent voltage and current sources will be studied. Emphasis is placed on DC, AC, and transient analysis techniques.

Prerequisites: APSC 112 or APSC 114, APSC 171, APSC 172, APSC 174

Corequisites: MTHE 235 or MTHE 237 or MTHE 225 or MTHE 232 (Differential Equations)

(0/0/0/38/13) (Mathematics/Natural Sciences/Complementary Studies/Engineering Science/Engineering Design)

Course Learning Outcomes (CLO)

By the end of this course, students should be able to:

CLO	Description	Indicator[1]
CLO 01	Understand the basic circuit components and the fundamental laws of circuit theories (KCL, KVL, Ohm's law,...)	KB-ES (Circuits and Devices)
CLO 02	Derive the mathematical model of resistive, and first and second order circuits	KB-ES (Circuits and Devices)
CLO 03	Solve resistive circuits using techniques such as current voltage divider, mesh-current, node-voltage, Thevenin and Norton, superposition...)	PA
CLO 04	Solve the initial condition and step responses of RC, RL and RLC circuits	PA
CLO 05	Solve sinusoidal steady-state response of RL, RC, and RLC circuits using techniques such as mesh-current, node-voltage, Thevenin and Norton, superposition	PA
CLO 06	Calculate power consumption in RL, RC and RLC circuits under steady-state sinusoidal excitation	PA
CLO 07	Investigate the initial and step response of RL, RC and RLC circuit	IN
CLO 08	Investigate the sinusoidal steady-state response of RL, RC and RLC circuits and power consummation is such circuits	IN

[1] For further information on graduate attributes and indicators, please click here.

COURSE EVALUATION

Assessment Weighting

Activity	Detail	Weight	CLOs
Mid-term	Oct. 24, 2025 (Friday, 5:30 pm to 7:30 pm)	**20% to 30%**	CLO 1, 2, and 3
Labs (6)	See Calendar document posted in onQ for lab scheduling	6 @ 5% each = **30% total**	All CLOs
Final Exam	During the exam period in December	**40% to 50%**	CLOs 4, 5, 6, 7, and 8
		100%	

Assessment Descriptions

Mid-term

There is an obligatory mid-term examination. The material covered in the mid-term will not be directly questioned in the final exam. The mid-term exam is closed book and will take place at 5:30 pm to 7:30 pm on October 24, 2025. The location will be announced later. Mid-term exam is from the material covered one week before the exam date.

Labs

Key document: "Lab Report Guideline" and **"Lab Info and Schedule"** are posted in onQ. You are expected to read, and understand those documents before entering the lab. Summary of these documents:

1. There are six Sections (005-010). Check the onQ calendar to find out when you should attend your labs.
2. There are six Labs (1-6). Lab Manuals containing a description of each lab will be posted on OnQ.
3. Lab groups will be formed during the first lab. You will be assigned to a group of maximum 3 students and that will be your group for duration of the term.
4. Labs will be assessed as follows:
    a. Prelab report: Each student has to have its own prelab report checked by the assigned TA.
    b. Lab report: Lab report has to be uploaded to onQ one week after the lab. Only one report is required for each group.
    c. Attendance: Attendance is taken at the beginning of the lab session with a 15-minute grace time. Absences can result in per-student Lab marking penalties.

Final Exam

The final exam is closed book. Students must write their exam on the day and time scheduled by the University. You should not schedule vacations, travel, etc. during the exam period. The Term and Session Dates will indicate the final exam period session dates in each term.

Learning Activity Descriptions

Assignments

There will be up to 6 bi-weekly assignments. Each assignment consists of complex problems that requires you to combine multiple course topics into your solutions. These assignments will help reinforce your knowledge of the course material and put it to practice. The solutions to the problems will be posted on OnQ after two weeks and will be partially discussed in the tutorial sessions. The assignments will not be marked for credit but are essential for understanding the course material.

Grading

All assessments in this course will receive numerical percentage marks. The final grade you receive for the course will be derived by converting your numerical course average to a letter grade according to the established Grade Point Index.

Accessing Your Final Grade

Your final grades will be posted on SOLUS. Official transcripts showing final grades will be available on the Official Grade Release Date. Please note that in official transcripts, a mark of IN (incomplete) is considered a grade, and your transcript is released with this grade.

Course Materials

Required Textbook

Nilsson and Reidel, *Electric Circuits*, 12th Edition (Electronic) (10th and 11th Editions work well)

Other Material

Please refer to the **"Lab Info and Schedule"** for additional details.
Lecture note and all other materials are accessible via onQ.

Required Calculator

A Casio 991 is required. **ONLY** this type of non-programmable, non-communicating calculator will be allowed during tests and exams.

Time Commitment

This course represents a study period of one semester spanning 12 weeks. Students can expect to invest on average 7-9 hours per week in this course. If you are 1) repeatedly spending 15+ hours/week to keep pace or 2) falling more than 4 weeks behind in your study, please consider contacting the Teaching Team. We will listen to your situation and attempt to provide advice, study tips, and/or information about Queen's resources that we think might help.

WEEKLY COURSE LEARNING OUTCOMES

Week	Learning Outcomes	Assessment
1	• Identify different applications of electric circuits in real life. • Define circuit variables (electric current, voltage, and power) from basic principles and apply the passive sign conventions. • Identify ideal current and voltage (dependent and independent) sources, • Identify active and passive elements. • Recognize open and short circuits.	
2	• Apply Kirchhoff's Laws: KVL, KCL. • Analyze electric circuits with dependent sources. • Manipulate complex electric circuits into simpler equivalent circuits: reduce resistive circuits, implement voltage and current dividers. • Identify different instruments used to measure current, voltage, and resistance, with a focus on both theoretical and practical considerations. • Apply Delta-Wye conversion technique in the time domain.	
3	• Define new terminologies such as a planar circuit, node, essential node, path, branch, essential branch, loop, and mesh. • Use a systematic approach to solve electric circuits. • Apply node-voltage method to analyze electric circuits, considering independent and dependent sources and special cases. • Apply mesh-current method to analyze electric circuits, considering independent and dependent sources and special cases	
4	• Determine (with reasoning) the most appropriate method to analyze a given problem (node-voltage vs. mesh-current). • Apply source transformation to simplify the process of circuit analysis, considering special cases. • Evaluate elements of Thevenin equivalent circuit for both independent and dependent sources. • Evaluate elements of Norton equivalent circuit for both independent and dependent sources.	
5	• Solve simple circuits for maximum power transfer • Calculating the response of a linear system using superposition principle	

Week	Learning Outcomes	Assessment
6	• Solve simple electric circuits including inductors and capacitors to find voltages, currents, power and stored energy. • Evaluate equivalent inductance and capacitance for inductors and capacitors connected in parallel and in series (Capacitive/inductive circuit reduction).	
7	• Determine the natural and step responses of first order RL circuits • Determine the natural and step responses of first order RC circuits	Mid-term 10/24/2024
8	• Evaluate the general solution for step and natural responses of RL and RC circuits • Solve electric circuits including sequential switching • Evaluate the transient voltage responses of parallel RLC circuits and identify the damping of the circuit. • Evaluate the natural responses of parallel RLC circuits (overdamped, & underdamped)	
9	• Evaluate the natural response of parallel RLC circuits (critically damped) • Evaluate the step response of parallel RLC circuits. • Evaluate the natural current responses of series RLC circuits and identify the damping of the circuits. • Evaluate the voltage step responses of series RLC circuits and identify the damping of the circuits.	
10	• Define parameters of sinusoidal sources. Calculate Root-Mean-Square (RMS) of sinusoidal currents and voltages. • Determine the sinusoidal response of a circuit with linear passive circuit elements. • Use different representations of phasors (polar and rectangular), and use phasors inverse to find the original sinusoidal function, and the time-domain expression. • Calculate phase shifts of passive circuit elements. • Implement KVL and KCL in the frequency domain.	

Week	Learning Outcomes	Assessment
11	• Evaluate equivalent impedances and admittances in both series and parallel arrangements. • Apply Delta-Wye transformations and sources transformations in the frequency domain. • Apply Thevenin and Norton principles to find the equivalent AC circuits for both independent and dependent sources in the frequency domain. • Apply node-voltage / mesh-current to analyze a given AC circuit. • Calculating the response of a linear system using superposition principle in the frequency domain, for sources having the same frequency and different frequencies.	
12	• Evaluate instantaneous, average and reactive power • Calculate the power for special circuits: purely resistive, purely inductive and purely capacitive. • Calculate the power factor for inductive loads (lagging) and capacitive loads (leading). • Calculate the rms (effective values) of voltages and currents in AC circuits.	

COURSE COMMUNICATION

COURSE ANNOUNCEMENTS

The instructor will routinely post course news in the Announcements section on the main course homepage on OnQ. Please sign up to be automatically notified by email when the instructor posts new information in the Announcements section. Instructions on how to modify your notifications are found in the **Begin Here** section of the OnQ course site.

DIRECT COMMUNICATIONS (NONCONFIDENTIAL)

Email is the primary way to communicate with the teaching team. To receive fastest response,
1. Include "**[ELEC 221]**" in the subject line
2. Please first reach out to the responsible TA (tutorial or lab). If the issue isn't resolved there, then contact the OnQ admin or the instructor.

These emails might be forwarded to other members of the teaching team.

CONFIDENTIAL MATTERS

If you have a confidential matter you would like to discuss with your instructor, you can email them directly. Include "**[ELEC 221] [CONFIDENTIAL]**" in the subject line. The instructor will not forward or excerpt from these emails without first asking for your written permission.

Office Hours

You will have the opportunity to interact with either a TA or the instructor through office hours. The instructor will provide a schedule of availability.

Absences (Academic Considerations) and missed assignments

For information on academic considerations due to extenuating circumstances, please review the information on the Smith Engineering website. Note that unacceptable reasons include extra-curricular activities, travel plans, generally behind on schoolwork, etc. Do not schedule travel during midterms and final exams, as travel is not an acceptable reason for granting academic considerations.

Ventus is an online portal that connects students, instructors, Queen's Student Accessibility Services, the Exam's Office, and other support services in the process to request, assess, and implement academic accommodations. To learn more about Ventus, visit A Visual Guide to Ventus for Students: https://www.queensu.ca/ventus-support/students/visual-guide-ventus-students

General Late Policy

In the event of extenuating circumstances, you must follow the policies for requesting an academic consideration (as described above). In the absence of an approved consideration request, the normal late penalty will apply as described in the assignment or any course/departmental policies. Assignment-specific late policies will be described in posted documents (syllabus, slides, assignment itself, etc.).

STANDARD QUEEN'S AND SMITH ENGINEERING POLICIES

Student Code of Conduct

Queen's University values maintaining an environment free of, and will not tolerate, harassment, discrimination, and reprisal. The Student Code of Conduct applies to all students at Queen's. It outlines the activities and behaviours that could be considered Non-Academic Misconduct (NAM). The Code also describes the NAM process and the sanctions that could be imposed on a student found responsible for a violation.
All students should be familiar with the Student Code of Conduct and related policies on sexual violence prevention and response and harassment and discrimination prevention and response.
https://www.queensu.ca/nonacademicmisconduct/policies

Copyright

Course materials created by the course instructor, including all slides, presentations, synchronous and asynchronous course recordings, handouts, tests, exams, and other similar course materials, are the intellectual property of the instructor. It is a departure from academic integrity to distribute, publicly post, sell or otherwise disseminate an instructor's course materials or to provide an instructor's course materials to anyone else for distribution, posting, sale or other means of dissemination, without the instructor's ***express consent***. A student who engages in such conduct may be subject to penalty for a departure from academic integrity and may also face adverse legal consequences for infringement of intellectual property rights and, with respect to recordings, potentially privacy violations of other students.

ACADEMIC INTEGRITY

As an engineering student, you have made a decision to join us in the profession of engineering, a long-respected profession with high standards of behaviour. As future engineers, we expect you to behave with integrity at all times. Please note that Engineers have a duty to:

- Act at all times with devotion to the high ideals of personal honour and professional integrity.
- Give proper credit for engineering work

The standard of behaviour expected of professional engineers is explained in the Professional Engineers Ontario Code of Ethics. Information on policies concerning academic integrity is available in the Queen's University Code of Conduct, in the Senate Academic Integrity Policy Statement, on the Smith Engineering website, and from your instructor.

Departures from academic integrity include plagiarism, use of unauthorized materials or services, facilitation, forgery, falsification, unauthorized use of intellectual property, and collaboration, and are antithetical to the development of an academic community at Queen's. Given the seriousness of these matters, actions which contravene the regulation on academic integrity carry sanctions that can range from a warning or the loss of grades on an assignment to the failure of a course to a requirement to withdraw from the University.

In the case of online or remotely proctored exams, impersonating another student, copying from another student, making information available to another student about the exam questions or possible answers, posting materials to online services, communicating with another person during an exam or about an exam during the exam window, or accessing unauthorized materials, including internet sources and using unauthorized materials, including smart devices, are actions in contravention of academic integrity.

GENERATIVE ARTIFICIAL INTELLIGENCE (AI) TOOLS – SPECIFIC TO ELEC 221

Students must submit their own work and cite the work that is not theirs. This course will follow a legal definition of what is "theirs," i.e. ownership. Read the Terms and Conditions of any AI model you use. If you are certain that you own full legal rights to the output content, then – *in this course* – you are allowed to use that content with or without citing the generating model.

For example, the Terms of Use applicable to OpenAI-provided models states, "to the extent permitted by applicable law, you (a) retain your ownership rights in Input and (b) own the Output. We hereby assign to you all our right, title, and interest, if any, in and to Output." That statement would mean that you are allowed to use OpenAI outputs in this course. During quizzes and exams, electronic devices are prohibited excepting a Casio 991 calculator (see section above).

Note regarding other courses: a legal definition of ownership used here is not necessarily the same as the *academic* definition(s) of authorship that are often used in other courses. Pay special attention to the course-by-course policies regarding AI because they vary and, in many cases, have serious academic consequences if not followed.

NETIQUETTE

In this course, you may be expected to communicate with your peers and the teaching team through electronic communication. You are expected to use the utmost respect in your dealings with your colleagues or when participating in activities, discussions, and online communication.

Following is a list of netiquette guidelines. Please read them carefully and use them to guide your online communication in this course and beyond.

1. Make a personal commitment to learn about, understand, and support your peers.
2. Assume the best of others and expect the best of them.
3. Acknowledge the impact of oppression on the lives of other people and make sure your writing is respectful and inclusive.
4. Recognize and value the experiences, abilities, and knowledge each person brings.
5. Pay close attention to what your peers write before you respond. Think through and re-read your writings before you post or send them to others.
6. It's alright to disagree with ideas, but do not make personal attacks.
7. Be open to be challenged or confronted on your ideas and challenge others with the intent of facilitating growth. Do not demean or embarrass others.
8. Encourage others to develop and share their ideas.

Invalid Exams

An exam may be declared invalid in case of an interruption in an in-person examination; if the instructions in a remote or online exam were not followed; if the student uploads wrong materials; or if a situation arises where the integrity of the exam cannot be verified. If an exam is declared invalid, the student may be granted a re-write.

ACADEMIC AND STUDENT SUPPORT

Queen's has a robust set of supports available to you including the Library, Student Academic Success Services (Learning Strategies and Writing Centre), and Career Services. Learners are encouraged to visit the Smith Engineering Current Students web portal for information about various other policies such as academic advisors, registration, student exchanges, awards and scholarships, etc. Students are also encouraged to review the information that is available in the EngQ Hub, posted in onQ.

Absences (Academic Considerations) and Academic Accommodations

For academic accommodations and considerations please review the information on the Smith Engineering website.

Accommodations for Disabilities

Queen's University is committed to working with students with disabilities to remove barriers to their academic goals. Queen's Student Accessibility Services (QSAS), students with disabilities, instructors, and faculty staff work together to provide and implement academic accommodations designed to allow students with disabilities equitable access to all course material (including in-class as well as exams). If you are a student currently experiencing barriers to your academics due to disability related reasons, and you would like to understand whether academic accommodations could support the removal of those barriers, please visit the QSAS website (https://www.queensu.ca/studentwellness/accessibility-services) to learn more about academic accommodations. To start the registration process with QSAS, click the ***Access Ventus*** button found on the Ventus student portal: https://www.queensu.ca/studentwellness/accessibility-services/ventus

Ventus is an online portal that connects students, instructors, Queen's Student Accessibility Services, the Exam's Office, and other support services in the process to request, assess, and implement academic accommodations. To learn more about Ventus, visit A Visual Guide to Ventus for Students: https://www.queensu.ca/ventus-support/students/visual-guide-ventus-students

For questions or assistance with requesting Academic Consideration or Accommodation, contact the Smith Engineering Program Advisor (Accommodations and Considerations) at engineering.aac@queensu.ca

Every effort has been made to provide course materials that are accessible. For further information on accessibility compliance of the educational technologies used in this course, please consult the links below.

EDUCATIONAL TECHNOLOGY	ACCESSIBILITY COMPLIANCE INFORMATION
onQ (Brightspace Learning Management System by D2L)	https://www.d2l.com/accessibility/standards/
MS-Teams	https://support.microsoft.com/en-us/office/accessibility-support-for-microsoft-teams-d12ee53f-d15f-445e-be8d-f0ba2c5ee68f
Zoom	https://zoom.us/accessibility

If you find any element of this course difficult to access, please discuss with your instructor how you can obtain an accommodation.

RELIGIOUS OBSERVANCE

Students in need of accommodation for religious observance are asked to speak to their professor within a week of receiving their syllabus. Note also that alternative assignments are considered a "reasonable accommodation" under the Ontario Human Rights Code. Students with questions about their rights and responsibilities regarding religious accommodation should contact the Chaplain Chaplain@queensu.ca.

OTHER HUMAN-RIGHTS BASED ACCESSIBILITY NEEDS

Students who have accessibility needs based on human-rights covered grounds, should inform their instructors within a week of receiving their syllabus. Student can also contact the contact the Smith Engineering Program Advisor (Accommodations and Considerations) at engineering.aac@queensu.ca for guidance.

TECHNICAL SUPPORT

Some basic comfort level with basic hardware and software skills are required for this course. If you require technical assistance, please contact Technical Support.

SUPPORTIVE PERSONAL COUNSELLING

If at any time you find yourself feeling overwhelmed, anxious, sad, lonely, or distressed, consider confidential personal counselling and wellness services offered by Smith Engineering and the Queen's student wellness services.