Fall 2018

Circuits and Signals ELEC 2501

Instructor

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Outline

Properties of signals. Basic circuit elements: voltage and current sources. Kirchhoff's laws, linearity, superposition. Thevenin and Norton's theorems. Circuit simplification. AC steady-state analysis: impedance, admittance, phasors, frequency response. Transient response of RL and RC circuits: form of response, initial and final conditions. RLC circuits: resonance.

Prerequisites

MATH 1005 and (PHYS 1004 or PHYS 1002) are pre-requisites and students without them will be de-registered.

Learning Outcomes

- Use appropriate SI units for currents, voltages and circuit elements
- Define voltage, current, power and their relationships
- Define and apply Ohm's law
- Analyze single-loop and single-node-pair circuits
- Determine the equivalent resistance of a network
- Transform wye resistor network into delta resistor network and vice versa
- Apply voltage and current division in circuits
- Analyze electric circuits to determine voltage and currents in the network
- Calculate currents and voltages in a circuit using loop analysis or nodal analysis
- Analyze electrical circuits using the principle of superposition
- Calculate Thévenin and Norton equivalent circuits for linear circuits
- Apply maximum power transfer theorem to determine optimal load
- Use circuit models for inductors and capacitors to calculate voltages, currents and powers
- Calculate voltages and currents in first-order transient circuits
- Perform phasor and inverse phasor transformations
- Draw phasor diagrams
- Calculate equivalent impedance and admittance for circuits consisting of basic circuit elements
- Apply circuit analysis techniques to frequency-domain circuits
- Calculate instantaneous, average, real, reactive and complex power and power factor in ac circuits
- Calculate average and RMS value for a periodic waveform
- Calculate the maximum average power transfer for a load in an ac circuit
- Sketch Bode plots for a network function
- Analyze series and parallel resonant circuits to determine voltages and currents in circuit

- Analyze basic filters such as low-pass, high-pass, band-pass and band-rejection filters to find voltages and currents in these circuits

Evaluation Scheme

Labs	20%
Assignment	5%
Quizzes	25%
Final	50%

Students need to obtain a minimum of 50% in their combined term mark (labs + quizzes) otherwise a grade of F could be assigned. A grade of at least 50% on the final exam is required to be eligible to pass the course. Students must complete all labs to be eligible to pass otherwise a grade of F can be assigned.

Textbook

- J. D. Irwin and R. M. Nelms, *Basic Engineering Circuit Analysis*, 11th Ed., Wiley, 2015

Laboratories

Each student is required to keep a laboratory notebook. All data, calculations, graphs etc. are to be kept in the notebook. As well, conclusions and discussions should be added at the end of the experiments. To facilitate handling of the lab reports, students may use a Carleton University Laboratory Report Booklet for each experiment (especially preferred and available in the bookstore). For each experiment 1-5 there is a pre-lab which is to be completed before coming to the lab. The notebooks will be collected at the end of each lab period. Reports must be neat and legible otherwise a discretionary deduction may be applied.

You must attend your scheduled lab section. In the event of a documented absence you may attend an alternate lab section with instructor or TA consent.
Lab exemptions are not granted under any circumstances for accreditation purposes.

PA

You are expected solve and understand the assigned problem sets. Try all the problems before the PA session. You will not be able to complete the problems if you have not looked at them before the PA period. The problem analysis period is provided to help you with difficult problems.

You must attend your scheduled PA section. You may attend an alternate lab section with instructor or TA consent.

Miscellaneous Notes

1. Students with disabilities requiring academic accommodations in this course are encouraged to contact a coordinator at the Paul Menton Centre for Students with Disabilities to complete the necessary letters of accommodation. After registering with the PMC, make an appointment to meet and discuss your needs with the course coordinator at least two weeks prior to the first in-class test or midterm exam. This is necessary in order to ensure sufficient time to make the necessary arrangements.
2. Requests for religious accommodations should be sent to the instructor by 28th Sept 2018.

Graduate Attributes:

An institution must demonstrate that graduates of its programs possess the attributes described below. In addition, the institution must implement and employ processes to demonstrate that program outcomes are being assessed in the context of these attributes, and that the results of such assessments will be applied to the further development of programs. The graduate attributes are:

1. **A knowledge base for engineering:** Demonstrated competence in university level mathematics, natural sciences, engineering fundamentals, and specialized engineering knowledge appropriate to the program.
2. **Problem analysis:** An ability to use appropriate knowledge and skills to identify, formulate, analyze, and solve complex engineering problems in order to reach substantiated conclusions.
3. **Investigation:** An ability to conduct investigations of complex problems by methods that include appropriate experiments, analysis and interpretation of data, and synthesis of information in order to reach valid conclusions.
4. **Design:** An ability to design solutions for complex, open-ended engineering problems and to design systems, components or processes that meet specified needs with appropriate attention to health and safety risks, applicable standards, and economic, environmental, cultural and societal considerations.
5. **Use of engineering tools:** An ability to create, select, apply, adapt, and extend appropriate techniques, resources, and modern engineering tools to a range of engineering activities, from simple to complex, with an understanding of the associated limitations.
6. **Individual and team work:** An ability to work effectively as a member and leader in teams, preferably in a multi-disciplinary setting.
7. **Communication skills:** An ability to communicate complex engineering concepts within the profession and with society at large. Such ability includes reading, writing, speaking and listening, and the ability to comprehend and write effective reports and design documentation, and to give and effectively respond to clear instructions.
8. **Professionalism:** An understanding of the roles and responsibilities of the professional engineer in society, especially the primary role of protection of the public and the public interest.
9. **Impact of engineering on society and the environment:** An ability to analyze social and environmental aspects of engineering activities. Such ability includes an understanding of the interactions that engineering has with the economic, social, health, safety, legal, and cultural aspects of society, the uncertainties in the prediction of such interactions; and the concepts of sustainable design and development and environmental stewardship.
10. **Ethics and equity:** An ability to apply professional ethics, accountability, and equity.
11. **Economics and project management:** An ability to appropriately incorporate economics and business practices including project, risk, and change management into the practice of engineering and to understand their limitations.

12. **Life-long learning:** An ability to identify and to address their own educational needs in a changing world in ways sufficient to maintain their competence and to allow them to contribute to the advancement of knowledge.

This course (ELEC 2501) will score attributes 1.4 Discipline Specific concept DOE-1, 2.2 Approach to problem, 2.3 Use of assumptions, 2.4 Interpreting the solution, 7.5 Notetaking skills and listening skills. They are scored through the responses provided in assignments, quizzes, pre-lab and lab reports, presentations, final exams. The graduate attribute scores may in some cases be derived from graded material, however the graduate attribute scores are not used in determination of the final grade for the course.