Carleton University Department of Electronics

Winter2025

ELEC4602: Electrical Power Systems

Introduction

In this course, students will learn the fundamentals of electrical power systems, with a focus on modeling, analysis, and control. The curriculum aims to provide students with the foundational knowledge needed to design power systems, as well as hands-on experience in their operation. Additionally, students will develop the skills to conduct research independently and collaboratively, and to effectively present their research findings.

Course Description and Requirements

Course Description:
Modeling and analysis of key power system components, including synchronous generators, transformers, transmission lines, and loads, as well as calculations of power flow in transmission systems, symmetrical and unsymmetrical power system faults, and other related factors.
Includes: Experiential Learning Activity
Prerequisite(s): ELEC 2602.
Lectures: 3 hours per week.
Laboratory and problem analysis: 3 hours per week alternate weeks.

Instructor

Professor: X. Wang, Room CB 4203
Email: xiaoyuw@carleton.ca
Course Webpage: on Brightspace

Textbook

1) J. D. Glover, M. Sarma, T. Overbye, Power System Analysis and, 6th Edition, Boston: Cengage Learning, 2016: Hardcover copy is $235.95 (Taxes not included)

Lecture Outline

In person

The following topics will be covered during the course lectures with an approximate schedule:

Week 1: Introduction to power systems, power system basics
Week 2: Synchronous generators, power Transformers

Week 3: Transmission line models
Week 4: Transmission line models
Week 5: Power system loads, power flow
Week 6: Power flow, symmetrical faults
Week 7: Symmetrical faults, symmetrical components
Week 8: Symmetrical components, unsymmetrical faults
Week 9: Unsymmetrical faults, system protection
Week 10: Transient stability
Week 11: Voltage and frequency control, Contingency analysis
Week 12: Economic dispatch, optimal power flow
Week 13: Power markets, review

Laboratory and Problem Analysis Sessions

3 hours (alternate weeks) as per schedule and location posted on Brightspace.

Notes for Labs

- There are 3 labs as follows:
  - Lab 0: Lab demo (no report)
  - Lab 1: Power flow
  - Lab 2: Symmetrical fault
  - Lab 3: Transient stability
- Labs are 3 hours in duration and will be held in Room CB 3104. Labs and PA sessions will be held according to the schedule shown on the course module in Brightspace. TA will take attendance at each lab session.
- Attend each lab punctually. Be prepared for the lab experiment by reading the lab manual before entering the lab.
- A lab report will be submitted online for each lab and by each student. Lab reports are due by noon on the next day of the lab. Late lab reports must still be submitted.

Notes for PA Sessions

- Several problems will be assigned during the semester as homework to help understand the lecture material, prepare for the midterm exam and final exam. To learn the course material, **IT IS ESSENTIAL THAT YOU ATTEMPT SOLUTIONS FOR THESE PROBLEMS BEFORE THE PA SESSION**. Solutions to these problems will be reviewed in the PA sessions.

Self-Declaration form and Deferred Term work

Students who claim illness, injury or other extraordinary circumstances beyond their control as a reason for missed term work are held responsible for immediately informing the instructor concerned and for submitting a self-declaration form no later than three (3) days after the date/deadline of term work including test/midterm, labs, assignments. Any alternate arrangements made with the instructor for submission of term work should be made as soon as possible but within 3 days of the missed due date. If this is not possible after discussion with the instructor, alternate arrangements must be made before the last day of classes in the term as published in the academic schedule.

Evaluation and Grading Scheme

The cumulative course grade will be determined as follows:

- 60% Final Exam on campus during normal scheduled exam period. Final exam is open book and is for evaluation purposes only; it will not be returned to students.
- 20% for midterm exam on campus scheduled during the class time. Midterm exam is open book.
- 20% Laboratories and students must complete and submit all 3 lab reports on due date and time.

To pass the course students need:

- Minimum overall grade of 50%.
- If you miss the midterm exam and have a valid reason, the equivalent of the term portion of the final grade will be shifted to the final exam. If you miss of the term exam without a valid reason, you will receive a grade of 0 on the term exam missed.
- The final exam is for evaluation purposes only and will not be returned to students. Textbook and lecture slides can be brought into the final exam and the midterm exams.

Deferred Final Examinations:

- Students who are unable to write the final examination because of a serious illness/emergency or other circumstance beyond their control may apply for accommodation by contact the Registrar's office. Consult the Section 4.3 of the University Calendar (https://calendar.carleton.ca/undergrad/regulations/academicregulationsoftheuniversity/examinations/)

Learning Outcomes

Upon successful completion of this course, students will be able to:

(1) explain principles of the focused power system components, i.e., synchronous generators, transformers, transmission lines and loads.
(2) calculate power flow of transmission systems.
(3) calculate symmetrical and unsymmetrical power system faults.
(4) understand the concept of power system transient stability.
(5) understand the concept of power system controls including voltage and frequency control, economic dispatch, and optimal power flow.
(6) review literature, identify questions, discuss solutions, and present results in the research area of power systems.

Graduate Attributes

The Canadian Engineering Accreditation Board requires graduates of undergraduate engineering programs to possess 12 attributes: Graduate-Attributes.pdf (engineerscanada.ca) or GA's. Courses in all four years of our programs evaluate students' progress towards acquiring these attributes. Aggregate data (typically, the data collected in all sections of a course during an academic year) is used for accreditation purposes and to guide improvements to programs. Some of the assessments used to measure GAs may also contribute to final grades; however, the GA measurements for individual students are not used to determine the student's year-to-year progression through the program or eligibility to graduate. Accreditation metrics are based on courses common to all students in a program.

This following list provides the GAs that will be measured in this course, along with the indicators that are intended to develop and assess these attributes.

Graduate Attribute and Level	**Indicator or Area of Specialization**	**Methods used to Evaluate**
GA-1 Knowledge base for Engineering Level I	DOE-7: Electronics DOE-8: Energy conversion and transmission	Dedicated questions on the final exam.
GA-2 Problem Analysis Level D	2.1 Problem definition 2.2 Approach to the problem 2.3 Use of assumptions 2.4 Interpreting the solution, validity of results	Dedicated questions on the final exam.
GA-4 Engineering Design Level D	4.1 Clear design goals 4.2 Detailed design specifications and requirements 4.4 Design solution(s) 4.5 Design implementation, task(s) definition 4.6 Alternate solution(s) definition 4.7 Evaluation based on engineering principles	Dedicated questions on the final exam.

Academic Integrity and Plagiarism

a) Please consult the Faculty of Engineering and Design information page about the Academic Integrity policy and our procedures: https://carleton.ca/engineering-design/current-students/fed-academic-integrity. Violations of the Academic Integrity Policy will result in the assignment of a penalty such as reduced grades, the assignment of an F in a course, a suspension or expulsion.

b) One of the main objectives of the Academic Integrity Policy is to ensure that the work you submit is your own. As a result, it is important to write your own solutions when studying and preparing with other students and to avoid plagiarism in your submissions. The University Academic Integrity Policy defines plagiarism as "presenting, whether intentionally or not, the ideas, expression of ideas or work of others as one's own." This includes reproducing or paraphrasing portions of someone else's published or unpublished material, regardless of the source, and presenting these as one's own without proper citation or reference to the original source.

Examples of violations of the policy include, but are not limited to:

- Any submission prepared in whole or in part, by someone else.
- Using another's data or research findings without appropriate acknowledgment.
- Submitting a computer program developed in whole or in part by someone else, with or without modifications, as one's own.
- Failing to acknowledge sources of information through the use of proper citations when using another's work and/or failing to use quotations marks.
- Unless explicitly permitted by the instructor in a specific course, the use of generative AI and similar tools to produce assessed content (such as text, code, equations, images, summaries, videos, etc.).

Academic Accommodations

You may need special arrangements to meet your academic obligations during the term. For an accommodation request the processes are as follows:

Pregnancy obligation: Contact us with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For accommodation regarding a formally-scheduled final exam, you must complete the Pregnancy Accommodation Form (click here).

Religious obligation: Contact us with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details click here.

Academic Accommodations for Students with Disabilities: The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or pmc@carleton.ca for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send us your Letter of Accommodation at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). After requesting accommodation from PMC, contact us, if needed, to ensure that accommodation arrangements are made.

You should request your academic accommodations in the Ventus Student Portal, for each course at the beginning of every term. For in-term tests or midterms, please request accommodations at least two (2) weeks before the first test or midterm.

Please consult the PMC website for the deadline to request accommodations for formally-scheduled exams (if applicable).

Survivors of Sexual Violence: As a community, Carleton University is committed to maintaining a positive learning, working and living environment where sexual violence will not be tolerated, and where survivors are supported through academic accommodations as per Carleton's Sexual Violence Policy. For more information about the services available at the university and to obtain information about sexual violence and/or support, visit: https://carleton.ca/equity/sexual-assault-support-services

Accommodation for Student Activities: Carleton University recognizes the substantial benefits, both to the individual student and for the university, that result from a student participating in activities beyond the classroom experience. Reasonable accommodation will be provided to students who compete or perform at the national or international level. Contact us with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist: https://carleton.ca/senate/wp-content/uploads/Accommodation-for-Student-Activities-1.pdf