

Department of Electronics
Carleton University

ELEC 4602: Electrical Power Engineering
Fall 2024

Instructor: Xiaoyu Wang

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Course Objectives:

This course covers the following contents:

- Modeling of synchronous generators, transformers, transmission lines, and loads
- Power flow
- Power system fault and protection
- Transient stability
- Power system controls
- Power markets

The main objectives of the course are:

- (1) to help students gain a thorough understanding of the basic concepts and techniques of power system components including synchronous generators, transformers, transmission lines, and loads;
- (2) to provide students with the fundamental knowledge necessary to design power systems;
- (3) to enable students to acquire hands-on experience on control and operation of power systems;
- (4) to give student opportunities to learn industrial cases and to interact with professionals from industry;
- (5) to train students to independently and collaboratively conduct research and present research results.

By the end of the course students should 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.

Course Schedule:

Lecture: 11:35 am - 12:55 am, Wednesday and Friday, ME4494

Laboratories: Friday A1 4:05 pm – 5:55 pm, ME4494

Midterm: Oct. 18 in class

(Tentative schedule)	PA/Lab	Lecture	Lecture
	A1	Wednesday (Lecture No)	Friday (Lecture No)
Week 1	N/A	0	1
Week 2	PA 1	2	3
Week 3		4	5
Week 4		6	7
Week 5	Lab	8	9
Week 6	Lab 1	10	11
Week 7	Lab 1	12	Midterm
Week 8	Fall Break		
Week 9	Lab 2	14	15
Week 10	Lab 2	16	17
Week 11		18	19
Week 12	Lab 3	20	21
Week 13	Lab 3	22	23
Week 14		24	25

Course Textbook:

Textbook Title: Power System Analysis and Design

Textbook Edition: 6th

Textbook Author: J. Duncan Glover, Mulukutla Sarma, Thomas Overbye

Textbook Publisher: Thomson-Engineering

The ISBN number: ISBN-10: 1305632133 ISBN-13: 978-1305632134

Reference Web Sources:

<https://overbye.engr.tamu.edu/course-2/ecen460fa2017/>

<https://courses.engr.illinois.edu/ece476/fa2016/>

<https://www.powerworld.com/gloveroverbyesarma>

Precluded course(s)

Prerequisite(s): ELEC 2602 Electric Machines and Power

Brightspace:

Brightspace will be used for communication and posting of course material, including lecture slides. The Brightspace site can be accessed from <https://brightspace.carleton.ca/d2l/home>. Please refer to the Brightspace site frequently in order to keep up-to-date with the course material that is posted there.

Marking Scheme:

Final exam	60%	(open book)
Midterm exam	20%	(open book)
Labs reports	20%	
Attendance	Need to attend at least 16 lectures to be allowed in the final exam	

Note:

1. 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.
2. In the event that 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 any of the term exams without a valid reason, you will receive a grade of 0 on the term exam missed.
3. In addition to having a passing grade for the entire course, students must also have obtained a passing grade in the laboratory portion of the course as well.
4. Students who are unable to write the final examination due to serious illness, emergency or other circumstances beyond their control may apply for accommodation by contact the Registrar's office. Consult [Section 4.3 of the University Calendar](#).
5. 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 making alternate arrangements with the instructor. In all cases this must occur no later than three (3) days after the term work was due. The alternate arrangement must be made before the last day of classes in the term as published in the academic schedule. Consult [Section 4.4 of the University Calendar](#).

Labs:

The objective of the labs is to gain hands on experience making measurements, recording and plotting data, not to write lengthy reports. Labs will be graded partly on the ability to demonstrate your experimental work to the TA, and partly on lab reports. Lab reports are normally due at the end of the laboratory period. Late labs are worth 0 and must still be handed in. In order to pass ELEC 4602, it is necessary to complete all 3 labs. If you miss a lab due to illness or other valid reason you must arrange a time to complete a make-up lab. All lab results are to be written directly in the space provided in the instruction sheets. A

completed lab will include the introduction sheets, instruction sheets and any closing sheets. All is to be stapled together and handed to the TA at the end of the lab period. The TA will also sign you in at the start of the lab and sign you out at the end of the lab. No laboratory exemptions are given to students who are repeating the course. Each laboratory is worth 5% of your final grade. All laboratory pages are to be printed by the student from CULearn.

Lab 1: Power flow

Lab 2: Symmetrical fault

Lab 3: Transient stability

PA Session 1: Review of phasors, complex power and three phase power

PA Session 2: Review of course contents

Lecture Topics: The list below indicates possible topics covered in the course.

Lecture 0: Introduction to power systems

Lecture 1: Power system basics

Lecture 2: Synchronous generators

Lecture 3: Power Transformers

Lecture 4: Transmission line models

Lecture 5: Transmission line models

Lecture 6: Transmission line models

Lecture 7: Transmission line models

Lecture 8: Power system loads, Power flow

Lecture 9: Power flow

Lecture 10: Power flow

Lecture 11: Symmetrical faults

Lecture 12: Symmetrical faults

Lecture 13: Symmetrical components

Lecture 14: Symmetrical components

Lecture 15: Unsymmetrical faults

Lecture 16: Unsymmetrical faults

Lecture 17: System protection

Lecture 18: Transient stability

Lecture 19: Transient stability

Lecture 20: Voltage and frequency control

Lecture 21: Contingency analysis

Lecture 22: Economic dispatch

Lecture 23: Optimal power flow

Lecture 24: Power markets

Lecture 25: Review

Accreditation Units

Math	Natural Science	Complementary Studies	Engineering Science	Engineering Design
			50%	50%

Learning outcomes / Graduate Attributes

The Canadian Engineering Accreditation Board requires graduates of undergraduate engineering programs to possess 12 attributes. 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 our 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.

This following list provides the GAs that will be measured in this course, along with the learning outcomes that are intended to develop abilities related to these attributes.

GA - Indicator	Assessment Tool
1.11.E - Knowledge base: Discipline-specific concept DOE-8: Electric machines and power	Based on some questions on the final exam.
1.5.M - Knowledge base: Discipline-specific concept MAE-2: Electrical and electronics	Based on some questions on the final exam.
2.1 - Problem analysis: Problem definition	Based on some questions on the final exam.
2.2 - Problem analysis: Approach to the problem	Based on some questions on the final exam.
2.3 - Problem analysis: Use of assumptions	Based on some questions on the final exam.
2.4 - Problem analysis: Interpreting the solution - validity of results	Based on some questions on the final exam.
4.1 - Design: Clear design goals	Based on some questions on the final exam.
4.2 - Design: Detailed design specifications and requirements	Based on some questions on the final exam.
4.4 - Design: Design solution(s)	Based on some questions on the final exam.
4.5 - Design: Design implementation / task(s) definition	Based on some questions on the final exam.
4.6 - Design: Alternate solution(s) definition	Based on some questions on the final exam.
4.7 - Design: Evaluation based on engineering principles	Based on some questions on the final exam.

Copyright

The materials (including the course outline and any slides, posted notes, videos, labs, project, assignments, quizzes, exams and solutions) created for this course and posted on this web site are intended for personal use and may not be reproduced or redistributed or posted on any web site without prior written permission from the author(s).

Generative Artificial Intelligence (AI)

Use of generative AI tools (such as ChatGPT) in course work is prohibited unless explicitly authorized by the course instructor for specific elements of the course. Submission of AI generated work without authorization may lead to an academic integrity investigation.

Advising and Counselling services

a) Engineering Academic Advising

The Engineering Academic Support Service : <https://carleton.ca/engineering-design/current-students/undergrad-academic-support/> assists undergraduate engineering students with course selection, registration, and learning support from first-year through to graduation.

Academic Advisors Contact : <https://carleton.ca/engineering-design/current-students/undergrad-academic-support/undergraduate-advisors/>

b) Student Mental Health Service

As a university student you may experience a range of mental health challenges that significantly impact your academic success and overall well-being. Carleton's Wellness Services Navigator <https://wellness.carleton.ca/navigator/> is designed to help students connect with mental health and wellness resources. If you need to talk to someone, please reach out for assistance: <https://carleton.ca/health/emergencies-and-crisis/>.

Learning and Working Environment

The University and all members of the University community share responsibility for ensuring that the University's educational, work and living environments are free from discrimination and harassment. Should you have concerns about harassment or discrimination relating to your age, ancestry, citizenship, colour, creed (religion), disability, ethnic origin, family status, gender expression, gender identity, marital status, place of origin, race, sex (including pregnancy), or sexual orientation, please contact the Department of Equity and Inclusive Communities at equity@carleton.ca

We will strive to create an environment of mutual respect for all through equity, diversity, and inclusion within this course. The space which we work in will be safe for everyone. Please be considerate of everyone's personal beliefs, choices, and opinions.

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 acknowledgement;
- submitting a computer program developed in whole or in part by someone else, with or without modifications, as one’s own; and
- failing to acknowledge sources of information through the use of proper citations when using another’s work and/or failing to use quotations marks.

Academic Accommodation

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

Pregnancy obligation

Write to me 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 see the Student Guide

Religious obligation

Write to me 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 see the Student Guide

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 me 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, meet with me to ensure accommodation arrangements are made. Please consult the PMC website for the deadline to request accommodations for the formally-scheduled exam (if applicable).

You can visit the Equity Services website to view the policies and to obtain more detailed information on academic accommodation at <http://www.carleton.ca/equity/>

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. Write to me 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>