

Department of Electronics
Carleton University

ELEC 4602: Electrical Power Systems
Fall 2022

Instructor: Dr. Shichao Liu, Assistant Professor

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TAs: TBD

Course Delivery: In-Person

Office Hour: 10:30 AM to 11:30 AM on Mondays (Remote or In-Person, To be discussed)

Course Objectives:

The main contents of the course are:

- (1) Power System Basics: Real Power, Reactive, Complex Power, Apparent Power, Power Factor, Single-Phase Triangle, Three-Phase Balanced System
- (2) Power System Components: Generators, Transformers, Transmission Lines
- (3) Power Flow Analysis: Nodal Network Matrix, Numerical Solutions
- (4) Power System Control: Automatic Generation Control

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) Model major components of power systems.
- (3) Calculate power flow of transmission systems.
- (4) Understand automatic generation control.
- (5) review literature, identify questions, discuss solutions, and present results in the research area of power system analysis.

Course Textbook:

Title: Power System Analysis and Design

Edition: 5th

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

Publisher: Thomson-Engineering.

References:

[1] Stephen J. Chapman, Electric Machinery Fundamentals, Fifth Edition, McGraw-Hill, BAE SYSTEMS Australia.

[2] Allan Hambley, Electrical Engineering: Principles & Applications (7th edition), Pearson, 2017.

[3] T K Nagsarkar and M S Sukhija, Power system analysis, 2nd edition, Oxford Higher Education, 2014.

BrightSpace:

BrightSpace will be used for communication and posting of course material, including lecture slides. 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	50%	(Closed Book)	Date: TBD
	Mid-term 1	15%	(Closed Book)	Date: TBD
	Mid-term 2	15%	(Closed Book)	Date: TBD
	PA Reports	10%		
	Labs reports	10%		

Note:

1. The final exam is for evaluation purposes only and will not be returned to students.
2. – **Textbook and lecture slides can be brought into the FINAL exam!!!**
3. – **Single Cheat Sheet (8½" × 11" page, double sides) can be brought into the Midterm exams!!**
4. If you miss any of the mid-exam without a valid reason, you will receive a grade of 0 on the mid-exam missed.
5. 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.
6. Each student will present in class at the end of the term. The performance of the presenter will be evaluated.

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 TAs, 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. To pass ELEC 4602, it is necessary to complete all 2 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 and any closing sheets. All is to be stapled together and handed to the TAs at the end of the lab period. The TAs 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 Lab is worth 5% of your final grade. All laboratory pages are to be printed by the student from BrightSpace.

Lab 1: Three-phase system and synchronous generator

Lab 2: Power Flow

Lecture Topics: The list below indicates **possible topics** and **tentative schedule** covered in the course (Schedule may be adjusted based on the actual progress).

Section I: Fundamentals

Lecture 1: Introduction to Power System

Lecture 2-5: Power System Basics: Real Power, Reactive, Complex Power, Apparent Power, Power Factor, single-phase triangle, Balanced Three Phase systems: Wye and Delta Connection, Three-Phase Power, triangle, three-phase vs single-phase

Section II: Components

Lecture 6: Power Transformers I (Chapman, chapter 2)

Lecture 7: Power Transformer II (Chapman, chapter 2)

Lecture 8: Power Transformer III (Chapman, chapter 2)

Lecture 9: Power Transformer IV (Chapman, chapter 2)

Lecture 10: Synchronous Generators I (Chapman, chapter 4)

Lecture 11: **Midterm Exam 1**

Lecture 12: Synchronous Generators II (Chapman, chapter 4)

Lecture 13: Synchronous Generators III (Chapman, chapter 4)

Lecture 14: Synchronous Generators IV (Chapman, chapter 4)

Lecture 15: **Guest Lecture (TBD)**

Lecture 16: Transmission Lines II (Steady-state operations chapter 5, Glover)

Lecture 17: Transmission Lines II (Steady-state operations, chapter 5, Glover)

Lecture 18: **Midterm Exam 2**

Section III: Analysis and Control

Lecture 19: Power Flow 1 (chapter 6, Glover)

Lecture 20: Power Flow 2 (chapter 6, Glover)

Lecture 21: Power Flow 3 (chapter 6, Glover)

Lecture 22: Power System Control I (chapter 12, Glover)

Lecture 23: Power System Control II (chapter 12, Glover)

-----Labs and Pas Schedule (Tentative)-----

Week 1: No PA/Lab

Week 2: Lab Demo

Week 3: PA 1

Week 4: Lab 1 (First Group)

Week 5: Lab 1 (Second Group)

Week 6: PA 2

Week 7: Lab 2 (First Group)

Week 8: Fall Break

Week 9: PA 3

Week 10: Lab 2 (Second Group)

Week 11: PA 4

Week 12: PA 5

Week 13: No PA/Lab

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/>

Covid Recommendations:

It is important to remember that COVID is still present in Ottawa. The situation can change at any time and the risks of new variants and outbreaks are very real. There are a number of actions you can take to lower your risk and the risk you pose to those around you including being vaccinated, wearing a mask, staying home when you're sick, washing your hands and maintaining proper respiratory and cough etiquette.

Feeling sick? Remaining vigilant and not attending work or school when sick or with symptoms is critically important. If you feel ill or exhibit COVID-19 symptoms do not come to class or campus. If you feel ill or exhibit symptoms while on campus or in class, please leave campus immediately. In all situations, you must follow Carleton's symptom reporting protocols.

Masks: Carleton has paused the COVID-19 Mask Policy, but continues to strongly recommend masking when indoors, particularly if physical distancing cannot be maintained. It may become necessary to quickly reinstate the mask requirement if pandemic circumstances were to change.

Vaccines: Further, while proof of vaccination is no longer required as of May 1 to attend campus or in-person activity, it may become necessary for the University to bring back proof of vaccination requirements on short notice if the situation and public health advice changes. Students are strongly encouraged to get a full course of vaccination, including booster doses as soon as they are eligible, and submit their booster dose information in cuScreen as soon as possible. Please note that Carleton cannot guarantee that it will be able to offer virtual or hybrid learning options for those who are unable to attend the campus.

All members of the Carleton community are required to follow requirements and guidelines regarding health and safety which may change from time to time. For the most recent information about Carleton's COVID-19 response and health and safety requirements please see the University's COVID-19 website and review the Frequently Asked Questions (FAQs). Should you have additional questions after reviewing, please contact covidinfo@carleton.ca.