University of Manitoba | Price Faculty of Engineering
Department of Electrical and Computer Engineering

Course Outline

ECE 4300 – Electrical Energy Systems 1

Fall 2021

Instructor
- Prof. Athula Rajapakse P.Eng
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Office Hours
- Mondays and Fridays,
  1:30PM–2:30PM,
  or by appointment

Teaching Assistants
- Kalana Dharmapala
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Contact Hours
- 4 credit hours
- Lectures:
  3 hours x 13 weeks = 39 hours
- Laboratories:
  3 hours x 5 weeks = 15 hours

Prerequisites:
- ECE 3650 Electric Machines

Course Website:
https://umanitoba.ca/umlearn

IMPORTANT NOTICE – Mandatory Requirement to Report

This course will be conducted using remote instruction. Students who are accessing the course from outside of Canada or the USA ***must notify the instructor*** and indicate in which country they are located. Access to software may be restricted from some countries and failure to comply with these restrictions may result in criminal prosecution.

Course Objectives

Modeling of power transmission systems, and introduction of computational methods for solving problems such as load flow, faults, and stability analysis.

Course Content

The following topics will be covered:

- Introduction to the main elements of a power system (power generation, transmission, and distribution) and the concepts of protection, operation and control.
- Review of basic concepts and machine models (three phase systems, per unit system, transformer and generator models).
- Power transmission line models and performance (calculation of line constants, two port models of transmission lines, line compensation design)
- Power flow analysis (Gauss-Seidel, Newton-Raphson and decoupled power flow)
- Fault analysis (symmetrical faults, short circuit capacity, symmetrical components, asymmetrical faults)
- Power system stability (swing equation, equal area criterion).

Textbook

Power System Analysis, Hadi Saadat, PSA Publishing, 3rd edition, 2010.

Academic Integrity

Students are expected to conduct themselves in accordance with the highest ethical standards of the Profession of Engineering and evince academic integrity in all their pursuits and activities at the university. As such, in accordance with the *General Academic Regulations* on *Academic Integrity*, students are reminded that plagiarism or any other form of cheating in examinations, term tests, assignments, projects, or laboratory reports is subject to serious academic penalty (e.g. suspension or expulsion from the faculty or university). A student found guilty of contributing to cheating by another student is also subject to serious academic penalty.

Learning Outcomes

1. Recognize the structure and operation of electricity generation, transmission and distribution systems and its impact on the society and environment.
2. Solve problems involving modeling, design and performance evaluation of power transmission lines.
3. Analyze power flow in power transmission networks and apply power flow results to solve simple planning and operation problems.
4. Calculate currents and voltages in a faulted power system under both symmetrical and asymmetrical faults, and relate fault currents to circuit breaker ratings.
5. Analyze the transient stability of simple power systems using equal area criterion.

Traditional Territories Acknowledgement

The University of Manitoba campuses and the Department of Electrical and Computer Engineering are located on the original lands of the Anishinaabeg, Cree, Oji-Cree, Dakota, and Dene peoples, and on the homeland of the Métis Nation.

We respect the Treaties that were made on these territories, we acknowledge the harms and mistakes of the past, and we dedicate ourselves to move forward in partnership with Indigenous communities in a spirit of reconciliation and collaboration.

Important Dates

- **Term Test**
  October 15th, 2021
  6:00PM – 8:00PM
  November 15th, 2021
  6:00PM – 8:00PM
- **Voluntary Withdrawal Deadline**
  November 23rd, 2021
- **National Day for Truth and Reconciliation**
  September 30th, 2021
  No classes or examinations
- **Thanksgiving Day**
  October 11th, 2021
  No classes or examinations
- **Remembrance Day**
  November 11th, 2021
  No classes or examinations
- **Fall Term Break**
  November 8th –12th, 2021
  No classes or examinations

Accreditation Details

Accreditation Units

- Mathematics: 0%
- Natural Science: 0%
- Complementary Studies: 0%
- Engineering Science: 100%
- Engineering Design: 0%

Graduate Attributes

KB: A knowledge base for engineering
PA: Problem analysis
IN: Investigation
DE: Design
ET: Use of engineering tools
IT: Individual and team work
CS: Communication skills
PR: Professionalism
IE: Impact of engineering on society/ environment
EE: Ethics and equity
EP: Economics and project management
LL: Life-long learning

Competency Levels

1 - Knowledge (Able to recall information)
2 - Comprehension (Ability to rephrase information)
3 - Application (Ability to apply knowledge in a new situation)
4 - Analysis (Able to break problem into its components and establish relationships.)
5 - Synthesis (Able to combine separate elements into a whole)
6 - Evaluation (Able to judge the worth of something)

Expected Competency Levels

Outcome	KB	PA	IN	DE	ET	IT	CS	PR	IE	EE	EP	LL
1	3	1					1		3			3
2	5	4	3	3	4		1					1
3	5	4	3	3	4		1					1
4	5	4	3	3	4		1					1
5	4	4	3		3		1					1

Evaluation

The final course grade will be determined from a student's performance on assignments, in laboratories, and on examinations. Calculators and one 8.5 x 11 page of hand-written notes (one side only) will be allowed on examinations. Students must complete all the laboratories in order to be eligible to receive a passing grade.

Component	Value (%)	Method of Feedback	Learning Outcomes Evaluated
Assignments	15	F, S	1, 2, 3, 4, 5
Laboratories	10	F, S	2, 3, 4, 5
Term Tests (2) ❖	35	F, S	1, 2, 3, 4
Final Examination	40	S	1, 2, 3, 4, 5

∗ Method of Feedback: **F** - Formative (written comments and/or oral discussion), **S** - summative (numerical grade)
❖ The better of two tests will be weighted at 20%, while the other will be weighted at 15%

CEAB Graduate Attributes Assessed

PA.3 – Analyzes and solves complex engineering problems.

IE.1 – Understands the social, environmental, economic, health, safety, legal and/or cultural aspects of engineering activities.

Copyright Notice

Retention of Student Work

Students are advised that copies of their work submitted in completing course requirements (i.e. assignments, laboratory reports, project reports, test papers, examination papers, etc.) may be retained by the instructor and/or the department for the purpose of student assessment and grading, and to support the ongoing accreditation of each Engineering program. This material shall be handled in accordance with the University's *Intellectual Property Policy* and the protection of privacy provisions of *The Freedom of Information and Protection of Privacy Act (Manitoba)*. Students who do not wish to have their work retained must inform the Head of Department, in writing, at their earliest opportunity.

Grading Scale

Letter	Mark
A+	95–100
A	85–94
B+	80–84
B	70–79
C+	65–69
C	55–64
D	45–54
F	< 45

Note: These boundaries represent a guide for the instructor and class alike. Provided that no individual student is disadvantaged, the instructor may vary any of these boundaries to ensure consistency of grading from year-to-year.

Requirements/Regulations

- Attendance at lectures and laboratories is essential for successful completion of this course. Students must satisfy each evaluation component in the course to receive a final grade.
- It is the responsibility of each student to contact the instructor in a timely manner if he or she is uncertain about his or her standing in the course and about his or her potential for receiving a failing grade. Students should also familiarize themselves with the University's *General Academic Regulations*, as well as Section 3 of the Faculty of Engineering *Academic Regulations* dealing with incomplete term work, deferred examinations, attendance and withdrawal.
- No programmable devices or systems (such as calculators, PDAs, iPods, iPads, cell phones, wireless communication or data storage devices) are allowed in examinations unless approved by the course instructor.
- Students should be aware that they have access to an extensive range of resources and support organizations. These include Academic Resources, Counselling, Advocacy and Accessibility Offices as well as documentation of key University policies e.g. Academic Integrity, Respectful Behaviour, Examinations and related matters.

Supplemental Resources