Elec Eng 4PM4
Electrical Power Systems
Winter 2018
Course Outline

CALENDAR/COURSE DESCRIPTION

Transmission lines; power flow studies, transient considerations of electrical generation, transmission, and distribution system elements; fault calculation; symmetrical and unsymmetrical faults; power system stability; future grids.

PRE-REQUISITES AND ANTI-REQUISITES

Prerequisite(s): Registration in level III or greater in Computer or Electrical Engineering; EE 3PI4, EE 4PL4.

COURSE CHEDULE

Lectures:	Tuesday	9:30 - 10:20 am	in	ABB 165
	Wednesday	9:30 - 10:20 am	in	ABB 165
	Friday	9:30 - 10:20 am	in	ABB 165
Tutorial:	Monday	12:30 - 1:20 pm	in	ABB 164
Labs:	Monday	5:30 - 8:20 pm	in	ITB 157

INSTRUCTOR OFFICE HOURS AND CONTACT INFORMATION

Dr. Mehdi Narimani
ITB-A320
narimanm@mcmaster.ca
905-525-9140 Ext. 27845

Office Hours: by appointment

TEACHING ASSISTANT OFFICE HOURS AND CONTACT INFORMATION

Zipan Nie
Office: ITB-A202
Niez4@mcmaster.ca
ext. 23151

Ahmed Hisham
Office: TBD
TBA
TBA

Kamal Zarei
Office:TBD
TBA
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Office Hours:
by appointment

COURSE WEBSITE/ALTERNATE METHODS OF COMMUNICATION

The Course Management System will be **Avenue** to Learn. The student is required to **check the system daily** for assignment, course related material, and posted announcements. http://avenue.mcmaster.ca/

COURSE OBJECTIVES

To develop system models for the analysis of unsymmetrical faults. To calculate system component parameters and undertake load flow studies. To study and understand the dynamic stability of electrical power systems. To gain an appreciation of electrical power system protection techniques. Define and qualify issues relating to electrical power quality and the impact thereof on plant and customer loads. To study emerging generation and connection concepts for large electrical power systems with-regard-to sustainable energy resources and their management.

Specific objectives will be to:

- Review: of electrical power systems and their major components; balanced three phase systems and power flow; balanced fault analysis.
- Transmission/distribution system parameters: overhead lines, resistance, inductance, capacitance; underground cables, resistance, inductance and capacitance; thermal management. Steady and transient models of short and long transmission lines.
- Fault analysis: symmetrical components; sequence impedances and voltage drops; positive, negative and zero sequence circuits and networks; asymmetrical faults in power systems. Protection: measurement of symmetrical components for protection; differential and zoned protection; condition monitoring and asset management.
- Power flow control and System Stability: steady-state and dynamic stability; transient parameters of synchronous generators; swing equation, equal area criteria, critical fault clearance time; excitation systems and governors, load flow analysis via direct and iterative methods; small and large disturbance studies and voltage stability studies.
- Parallel operation of Synchronous Generators in power systems
- FACTS and HVDC Systems: example installations, operating voltages and power flows; converter topologies and control of real and reactive power flows; fault levels and management.

INTENDED LEARNING OUTCOMES

Category of outcome	Students should be able to:	Assessment measure
Knowledge and understanding	• Understand the basic concepts of electric power systems • Understand the concept of power flow in power systems • Understand the importance of component and system dynamics, transients and steady-state operation. • Understand the concept of balanced and unbalanced faults. • Understand the impact of new generation and system concepts.	Labs., Assignments and final exam.
Intellectual skills	• Analyse and interpret electrical component models, parameters and how design impacts on their variability. • Translate application demands to simple design specifications.	Labs., and final exam.
Practical skills	• Simulate the operation of electrical power systems, interpretation of results, and validation via analytic test cases.	Labs., and final exam.
Transferable skills and personal qualities	• Perform literature search; scientific report writing; generalisation of subject core. • Plan and undertake learning activities based on the module resources.	Assignment.

COURSE MATERIALS

Required Items:

- Glover, J. D., Sarma, S. M. and Overbye, T. J.: "Power System Analysis and Design", Cengage Learning, ISBN-10: 1-111-42577-9;

Optional Texts:

- Guile, A.E. and Paterson, W.: "Electrical Power Systems", Pergamon Press;
- Shepherd, J., Morton, A.H and Spense, L.F.: "Higher Electrical Engineering", Pitman;
- Say, M.G.: "Alternating Current Machines",
- Pitman. Weedy, B.M.: "Electric Power Systems", 3rd edition Wiley;
- Grainger, J. J. and Stevenson W.D.: "Power Systems Analysis", McGraw-Hill, ISBN: 0070612935;
- Harrison, J.A.: "An Introduction to Electric Power Systems", Longman.
- Saadat, H.: "Power System Analysis", McGraw-Hill.

Calculator:

- Any calculator can be used on quizzes, tests and examinations.

COURSE OVERVIEW

At certain points in the course it may make good sense to modify the schedule outlined below. The instructor reserves the right to modify elements of the course and will notify students accordingly (in class and post any changes to the course website).

Topic	Number of Sessions
1. Review of Three-phase Power Systems	3
2. Review of Power Transmission Lines (**Topic 1**)	6
3. Power Flow Studies (**Topic 2**)	6
4. Symmetrical Faults (**Topic 3**)	3
5. Symmetrical Components (**Topic 4**)	3
6. Unsymmetrical faults (**Topic 5**)	6
7. Power System Stability (**Topic 6**)	5
8. Future Grids (**Topic 7**)	4
Total sessions	**36**

ASSESSMENT

Component	Weight
Assignment	10%
Laboratories (3 x 6%)	18%
Midterm Exam (2.5 hours) , Monday Feb. 12, 2018 ; 5:30 - 8:00pm	22%
Final Exam (2.5 hours)	50%
Total	**100%**

ACCREDITATION LEARNING OUTCOMES

As part of the accreditation process for our undergraduate degrees, the Department is engaging in a "continuous improvement" process, part of which involves the assessment of the development of desirable attributes amongst a student cohort as a whole. This process is independent of the grading of individual students. In this course, indicators related to the development of the following attributes will be measured: Problem Analysis, Investigation, Design, Professionalism, and Impact of Engineering on Society and the Environment.

ACADEMIC INTEGRITY

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity.
Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university.

It is your responsibility to understand what constitutes academic dishonesty. For information on the various types of academic dishonesty please refer to the Academic Integrity Policy, located at
http://www.mcmaster.ca/academicintegrity
The following illustrates only three forms of academic dishonesty:

1. Plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained.
2. Improper collaboration in group work.
3. Copying or using unauthorized aids in tests and examinations.

ACADEMIC ACCOMMODATIONS

Students who require academic accommodation must contact Student accessibility Services (SAS) to make arrangements with a Program Coordinator. Academic accommodations must be arranged for each term of study. Student Accessibility Services can be contact by phone at 905.525.9140 ext. 28652 or e-mail at sas@mcmaster.ca. For further information, consult McMaster University's Policy for Academic Accommodation of Students with Disabilities.

NOTIFICATION OF STUDENT ABSENCE AND SUBMISSION OF REQUEST FOR RELIEF FOR MISSED ACADEMIC WORK

In the event of an absence for medical or other reasons, students should review and follow the Academic Regulation in the Undergraduate Calendar "Requests for Relief for Missed Academic Term Work": http://www.mcmaster.ca/msaf/

NOTICE REGARDING POSSIBLE COURSE MODIFICATION

The instructor and university reserve the right to modify elements of the course during the term. The university may change the dates and deadlines for any or all courses in extreme circumstances. If either type of modification becomes necessary, reasonable notice and communication with the students will be given with explanation and the opportunity to comment on changes. It is the responsibility of the student to check their McMaster email and course websites weekly during the term and to note any changes.

REFERENCE TO RESEARCH ETHICS

The two principles underlying integrity in research in a university setting are these: a researcher must be honest in proposing, seeking support for, conducting, and reporting research; a researcher must respect the rights of others in these activities. Any departure from these principles will diminish the integrity of the research enterprise. This policy applies to all those conducting research at or under the aegis of McMaster University. It is incumbent upon all members of the university community to practice and to promote ethical behaviour. To see the Policy on Research Ethics at McMaster University, please go to http://www.mcmaster.ca/policy/faculty/Conduct/ResearchEthicsPolicy.pdf.

Electrical and Computer Engineering Lab Safety

Information for Laboratory Safety and Important Contacts

This document is for users of ECE instructional laboratories in the Information Technology Building.

This document provides important information for the healthy and safe operation of ECE instructional laboratories. This document is required reading for all laboratory supervisors, instructors, researchers, staff, and students working in or managing instructional laboratories in ECE. It is expected that revisions and updates to this document will be done continually. A McMaster University lab manual is also available to read in every laboratory.

General Health and Safety Principles

Good laboratory practice requires that every laboratory worker and supervisor observe the following:

1. Food and beverages are not permitted in the instructional laboratories.
2. A Laboratory Information Sheet on each lab door identifying potential hazards and emergency contact names should be known.
3. Laboratory equipment should only be used for its designed purpose.
4. Proper and safe use of lab equipment should be known before using it.
5. The course TA leading the lab should be informed of any unsafe condition.
6. The location and correct use of all available safety equipment should be known.
7. Potential hazards and appropriate safety precautions should be determined, and sufficiency of existing safety equipment should be confirmed before beginning new operations.
8. Proper waste disposal procedures should be followed.

Location of Safety Equipment

Fire Extinguisher
On walls in halls outside of labs

First Aid Kit
ITB A111, or dial “88” after 4:30 p.m.

Telephone
On the wall of every lab near the door

Fire Alarm Pulls
Near all building exit doors on all floors

Who to Contact

Emergency Medical / Security: On McMaster University campus, call Security at extension **88** or **905-522-4135** from a cell phone.
Non-Emergency Accident or Incident: Immediately inform the TA on duty or Course Instructor.
University Security (Enquiries / Non-Emergency): Dial 24281 on a McMaster phone or dial 905-525-9140 ext. 24281 from a cell phone.
See TA or Instructor: For problems with heat, ventilation, fire extinguishers, or immediate repairs
Environmental & Occupational Health Support Services (EOHSS): For health and safety questions dial 24352 on a McMaster phone or dial 905-525-9140 ext. 24352 from a cell phone.
ECE Specific Instructional Laboratory Concerns: For non-emergency questions specific to the ECE

In Case of a Fire (Dial 88)

When calling to report a fire, give name, exact location, and building.

1. Immediately vacate the building via the nearest Exit Route. Do not use elevators!
2. Everyone is responsible for knowing the location of the nearest fire extinguisher, the fire alarm, and the nearest fire escape.
3. The safety of all people in the vicinity of a fire is of foremost importance. But do not endanger yourself!
4. In the event of a fire in your work area shout "*Fire!*" and pull the nearest fire alarm.
5. Do not attempt to extinguish a fire unless you are confident it can be done in a prompt and safe manner utilizing a hand-held fire extinguisher. Use the appropriate fire extinguisher for the specific type of fire. Most labs are equipped with Class A, B, and C extinguishers. Do not attempt to extinguish Class D fires which involve combustible metals such as magnesium, titanium, sodium, potassium, zirconium, lithium, and any other finely divided metals which are oxidizable. Use a fire sand bucket for Class D fires.
6. Do not attempt to fight a major fire on your own.
7. If possible, make sure the room is evacuated; close but do not lock the door and safely exit the building.

Clothing on Fire

Do not use a fire extinguisher on people

1. Douse with water from safety shower immediately or
2. Roll on floor and scream for help or
3. Wrap with fire blanket to smother flame (a coat or other nonflammable fiber may be used if blanket is unavailable). Do not wrap a standing person; rather, lay the victim down to extinguish the fire. The blanket should be removed once the fire is out to disperse the heat.

Equipment Failure or Hazard

Failure of equipment may be indicative of a safety hazard - You must report all incidents.

Should you observe excessive heat, excessive noise, damage, and/or abnormal behaviour of the lab equipment:

1. Immediately discontinue use of the equipment.
2. In Power Lab, press wall-mounted emergency shut-off button.
3. Inform your TA of the problem.
4. Wait for further instructions from your TA.
5. TA must file an incident report.

Protocol for Safe Laboratory Practice

Leave equipment in a safe state for the next person - if you're not sure, ask!

In general, leave equipment in a safe state when you finish with it. When in doubt, consult the course TA.

Defined Roles

TA	The first point of contact for lab supervision	
ECE Lab Supervisor	Steve Spencer- ITB 147	steve@mail.ece.mcmaster.ca
ECE Chair	Tim Davidson- ITB A111	davidson@mcmaster.ca
ECE Administrator	Kerri Hastings- ITB A111	hastings@mcmaster.ca
ECE Course Instructor	Please contact your specific course instructor directly	