ELEC ENG 3PI4
Energy Conversion

COURSE OUTLINE

Please refer to course website for updated information.

COURSE DESCRIPTION

This course examines the fundamentals of transformers and ac electric machines. Selection of motors, calculating the ratings, starting, and braking are also covered. Lab experiments are based on the lectures given.

PRE-REQUISITES AND ANTI-REQUISITES

Pre-requisite(s): ElecEng 2CJ4, 2FH3 or 2FH4 and 2CI5
Anti-requisite(s): none

SCHEDULE

Lectures:	Tuesday	9:30 - 10:20 am	ITB-AB102
	Wednesday	9:30 - 10:20 am	ITB-AB102
	Friday	9:30 - 10:20 am	ITB-AB102
Tutorial:	Tuesday	11:30am - 12:20pm	ABB-102
Labs:	Monday to Friday **Every Other Week**	2:30 - 5:20 pm	ITB-AB110

INSTRUCTOR

Dr. Mehdi Narimani
Email: narimanm@mcmaster.ca
Office: ITB-A320
Phone: 905-525-9140 Ext. 27845
Office Hours: by appointment

TEACHING ASSISTANTS

Names, contact information and office hours are provided on the course website.

COURSE WEBSITE

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

By the end of this course students should be able to analyze, model, and predict the performance of power devices and systems including single-phase and balanced three-phase systems, transformers, and generators and motors. In addition the students must be able to measure the parameters for these models using standard tests.

After completing this course, the student should be able to do the following things correctly.

1. Given an electromechanical system including an electric machine and a mechanical load with different torque-speed characteristics, find torque, acceleration, speed, position, and power.
2. Given an energy conversion system, using fundamentals of electromagnetism, draw and analyze the equivalent electric circuit.
3. Derive and apply the relevant equations of single-phase and three-phase transformers.
4. Derive and apply the relevant equations of three-phase induction machines: motors and generators.
5. Derive and apply the relevant equations of multi-phase permanent-magnet synchronous motors and three-phase synchronous generators.
6. Derive and apply the fundamental equations of special motor drives: DC Machines, switched reluctance, stepper, brush-less DC, and electronic motor drives.

ASSUMED KNOWLEDGE

It is assumed that the students have the knowledge of circuit analysis and fundamental of electromagnetics.

COURSE MATERIAL

Required Items:

- Textbook: *"Electric Machinery Fundamentals"* by Stephen J. Chapman, McGraw---Hill, 5th edition, 2012, ISBN: 9780073529547.

Optional Texts (these are the course references):

- *"Electric Machines and Drives"*, Gordon R. Slemon, Addison Wesley, ISBN 0-201-57885-9, 1992.
- *"Fundamentals of Electric Drives"*, By: M. A. El-Sharkawi, 1st Edition, PWS Pub. Co., ISBN: 0- 534-95222-4, 2000.
- *"Electric Motor Drives: Modeling, Analysis, and Control"*, By: R. Krishnan, 1st Edition, Prentice Hall, ISBN: 0-13-091014-7, 2001.

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. Course Introduction	5
2. Introduction to Energy Conversion	4
3. Transformers	6
4. Fundamentals of AC machines	5
5. Synchronous Generators	6
6. Induction Motors	7
7. Other machines	3
Total sessions	**36**

LABORATORY OVERVIEW

Week	Topic
5-6	Transformers
8-9	Three-phase Systems
10-11	Synchronous Generators
12-13	Induction Motors

LABORATORY OPERATION

- At the beginning of every term, every Undergraduate student using an ECE Lab is required to complete the ECE Lab Safety Quiz (one completed quiz covers every course that term). The quiz and other information is provided on the webpage: https://www.eng.mcmaster.ca/ece/resources#health-safety
- Access to all labs is restricted in the interest of security and safety. Information on accessing and using the lab can be found on the webpage: https://www.eng.mcmaster.ca/ece/labs-and-health-safety#Labs-Access-and-Use
- The TA will open the lab at regularly scheduled lab times.
- The labs for this course will be held in ITB-AB110.
- The labs will be performed in groups of two or three students.
- The TAs and the instructor reserve the right to interview students to assess their understanding of the lab material. Such interviews will be held at random and we reserve the right to adjust the lab mark based on the outcome of the interview.

ASSESSMENT

Course Evaluation:

Components	Weight
Lab Evaluation (four labs)	16%
Midterm Exam (two 2.5-hour exams)	34%
Final Exam (3 hours, scheduled and supervised by the registrar)	50%
Total	**100%**

Note:

The instructor(s) reserves the right to choose the format (i.e. written or oral) of any deferred midterm or exam in this course. Please note that announcements concerning any type of graded material may be in any format (e.g., announcements may be made only in class). Students are responsible for completing the graded material regardless of whether they received the announcement or not.

Written Work and Late Submissions:

All written work will be marked on clarity of writing and organization, as well as content and analysis. All assignments must be properly referenced, with footnotes and a bibliography. Use the Turabian (Chicago) style for referencing; examples can be found at McMaster University Library Guides or in Berkin and Anderson, chapter 11. Students are encouraged to visit the Centre for Student Development to improve their essay skills (MUSC B107; x24711). For information about the Writing Clinic and the Centre's other services, visit the Centre's website: http://csd.mcmaster.ca Chapter 12 in Berkin and Anderson is also useful.

All written work must be submitted in tutorial, on the due date. Do not submit assignments by email and do not slide them under the instructor's door. Late assignments will be penalized 5% a day (weekends will count as one day). Late penalties will not be waived unless your Faculty/Program Office advises the instructor that you have submitted to that office the appropriate documentation to support your inability to submit the work by the due date.

ACCREDITATION LEARNING OUTCOMES

Note: The *Learning Outcomes* defined in this section are measured throughout the course and form part of the Department's continuous improvement process. They are a key component of the accreditation process for the program and will not be taken into consideration in determining a student's actual grade in the course. For more information on accreditation, please ask your instructor or visit: http://www.engineerscanada.ca .

Outcomes	Indicators	Measurement Method(s)
Demonstrate ability to select appropriate numerical methods when solving a certain type of problems.	2.2	exam
Able to recognize and discuss applicable theory knowledge base	3.1	exam
Capable of selecting appropriate model and methods and identify assumptions and constraints	3.2	exam
Include appropriate health and safety considerations	4.5	exam
Determines and employs applicable standards and codes of practice.	4.6	exam

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 www.mcmaster.ca/academicintegrity .

The following illustrates only three forms of academic dishonesty:
• Plagiarism, e.g. the submission of work that is not one’s own or for which other credit has been obtained.
• Improper collaboration in group work.
• Copying or using unauthorized aids in tests and examinations.

ACADEMIC ACCOMMODATIONS

Students with disabilities who require academic accommodation must contact Student Accessibility Services (SAS) to make arrangements with a Program Coordinator. Student Accessibility Services can be contacted by phone 905-525-9140 ext. 28652 or e-mail sas@mcmaster.ca . For further information, consult McMaster University’s Academic Accommodation of Students with Disabilities policy.

Students requiring academic accommodation based on religious, indigenous or spiritual observances should follow the procedures set out in the RISO policy. Students requiring a RISO accommodation should submit their request to the Engineering Student Services office normally within 10 working days of the beginning of term in which they anticipate a need for accommodation or to the Registrar's Office prior to their examinations.

Students should also contact their instructors as soon as possible to make alternative arrangements for classes, assignments, and tests.

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".

EXTREME CIRCUMSTANCES

The University reserves the right to change the dates and deadlines for any or all courses in extreme circumstances (e.g., severe weather, labour disruptions, etc.). Changes will be communicated through regular McMaster communication channels, such as McMaster Daily News, A2L and/or McMaster email.

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.

ON-LINE STATEMENT FOR COURSES REQUIRING ONLINE ACCESS OR WORK

In this course, we will be using Avenue to Learn (http://avenue.mcmaster.ca/). Students should be aware that, when they access the electronic components of this course, private information such as first and last names, user names for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in this course will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure, please discuss this with the course instructor.

www.eng.mcmaster.ca/ece

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.

ELEC ENG 3PI4
Section/s: C01
Academic Year: 2019/20
Term: Winter

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 laboratories, please contact 24103.

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 a 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 Course Instructor	Please contact your specific course instructor directly	
ECE Administrator	Kerri Hastings- ITB A111	hastings@mcmaster.ca
ECE Chair	Tim Davidson- ITB A111	davidson@mcmaster.ca