



# ENGG\*3510 Electromechanical Devices

Fall 2019

Section(s): C01

School of Engineering

Credit Weight: 0.50

Version 1.00 - September 04, 2019

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## 1 Course Details

### 1.1 Calendar Description

The aim of this course is to develop an understanding of the electrical and electromechanical principles and their applications as devices used in engineering. The course covers magnetic fields of currents and coils; magnetic materials; magnetic circuits; induced, electric and magnetic fields (EMF), inductance, transformers magnetic forces, permanent magnets and electromagnets. The course examines the principles of variable-reluctance devices, stepper motors, moving-coil devices, direct current (DC) and alternating current (AC) motors. Semiconductors materials and devices, diodes, and transistors; principles of modern electronic devices and their applications in circuits; as well as operational amplifiers and digital logics are also studied.

**Pre-Requisites:** ENGG\*2450, PHYS\*1010

### 1.2 Timetable

The course registration details on Webadvisor will determine the lab and tutorial attendance times. The course name Electromechanical Devices will be ENGG\*3510\*010XX. XX is the section number for the lab and tutorial respectively. For example, "ENGG\*3510\*01062" corresponds to a Thursday lab from 13:30 – 15:20 and a Monday tutorial from 19:00 – 19:50.

Lectures:

Tuesday	11:30 – 12:50	MCLN 102
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Thursday	11:30 – 12:50	MCLN 102
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Labs:

Thursday	Sec	61, 62, 63	13:30– 15:20	RICH 2510
Tuesday	Sec	51, 52, 53	15:30 – 17:20	RICH 2510
Wednesday	Sec	31, 32, 33	14:30 – 16:20	RICH 2510
Wednesday	Sec	41, 42, 43	8:30 AM– 10:20	RICH 2510
Thursday	Sec	21, 22, 23	15:30 – 17:20	RICH 2510
Friday	Sec	11, 12, 13	10:30 AM– 12:20	RICH 2510

**Note:** for the labs, contact **only the TA(s)** who was/were in charge of your lab (TA contacts are on page 3).

**Tutorials:**

Monday Sec 12, 22, 32, 42, 52, 62 19:00 – 19:50 ALEX 259

Thursday Sec 13, 23, 33, 43, 53, 63 19:00 – 19:50 ROZH 105

Wednesday Sec 11, 21, 31, 41, 51, 61 19:00 – 19:50 ALEX 117

**Note:** for tutorials, please contact only Elyse Hill (TA contact is on page 3).

## 1.3 Final Exam

Final Exam: 02:30PM - 04:30PM (2019/12/13)

Exam time and location is subject to change. Please see WebAdvisor for the latest information.

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## 2 Instructional Support

### 2.1 Instructional Support Team

**Instructor:** Mohammad Biglarbegan  
**Email:** mbiglarb@uoguelph.ca  
**Telephone:** +1-519-824-4120 x56248  
**Office:** THRN 2339  
**Office Hours:** By appointment

**Lab Technician:** Barry Verspagen  
**Email:** baverspa@uoguelph.ca  
**Telephone:** +1-519-824-4120 x58821  
**Office:** THRN 1138

### 2.2 Teaching Assistants

**Teaching Assistant:** Elyse Hill  
**Email:** ehill06@uoguelph.ca  
**Office Hours:** TBA  
 Responsible for **tutorials** only.

**Teaching Assistant:** Andrew Lee  
**Email:** alee32@uoguelph.ca  
**Office Hours:** TBA  
 Responsible for **labs** only.

**Teaching Assistant:** Haniya Saleh  
**Email:** hsaleh@uoguelph.ca  
**Office Hours:** TBA  
 Responsible for **labs** only.

**Teaching Assistant:** Palak Patel  
**Email:** palak@uoguelph.ca  
**Office Hours:** TBA  
 Responsible for **labs** only.

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## 3 Learning Resources

### 3.1 Required Resources

**Course Website (Website)**

<http://courselink.uoguelph.ca>

Course material, news, announcements, and grades will be posted regularly to the ENGG\*3510 Courselink site. You are responsible for checking the site regularly.

**Students are expected to attend all of the lectures. Students are responsible for whatever material is taught in the class. Note that the textbook may not have all of the material taught in the class (Textbook)**

“Electric Machinery Fundamental”, by S. J. Chapman, McGraw Hill, 5th edition, 2011

\* Purchase of the textbook is optional.

## 3.2 Additional Resources

**Lecture Information (Notes)**

Lecture notes will be posted on Courselink after each class.

**Lab Information (Notes)**

The handouts for all the lab sessions will be posted on the Courselink. All types of resources regarding tutorials, links to web pages can be found in this section.

Note: For the labs, please contact only the lab TAs (designated as Lab TAs on Page 3).

**Miscellaneous Information (Other)**

Other information related to Electromechanical Devices are also posted on the web page.

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## 4 Learning Outcomes

Electromechanical systems are used everywhere ranging from basic home devices to advanced machines used in industry. As a mechanical engineer, one should have a general understanding on these devices. The course covers magnetic material, permanent magnets, magnetic circuits and related topics such as EMF, MMF, inductance, etc. It also covers transformers, electric machines (motors and generators) both DC and AC, special motors such as stepper, servo, as well as speed control of motors. You will learn how the fundamental laws of magnetism are used in electromechanical systems such as transformers, electromotors, or generators. By the end of the term, you should have a good understanding of such devices.

### 4.1 Course Learning Outcomes

By the end of this course, you should be able to:

1. Apply the fundamental laws of physics and electromagnetism to electromechanical

devices.

2. Describe magnetic material, their properties, and explain the B H curve.
3. Analyze and synthesize magnetic circuits to be able to understand the underlying principles of many electromechanical devices, transformers, etc.
4. Analyze semi conductor devices such as Diodes, Transistors, and their applications
5. Analyze transformers and utilize the knowledge of magnetic circuits to be able to analyze them.
6. Utilize the knowledge of electromagnetism to analyze, and design Linear DC machines: DC motors and generators.
7. Learn, understand, and be able to analyze the principles as well as applications of rotary DC machines: both DC motors and DC generators.
8. Explain and discuss the techniques (advantages and limitations) used for speed control of DC motors.
9. Explain the principles and analyze rotary AC machines: both AC motors and AC generators, and analyze them, and list their applications.
10. Explain special purpose motors, how they operate, and their applications.
11. Perform experiments with several electromechanical devices and concisely and articulately communicate the results through formal reports.

## 4.2 Engineers Canada - Graduate Attributes (2018)

Successfully completing this course will contribute to the following:

#	Outcome	Learning Outcome
1	Knowledge Base	1, 2, 4, 5, 6, 7, 8, 9, 10
1.1	Recall, describe and apply fundamental mathematical principles and concepts	1
1.2	Recall, describe and apply fundamental principles and concepts in natural science	1, 2, 4, 5, 6, 7
1.3	Recall, describe and apply fundamental engineering principles and concepts	2, 4, 5, 6, 7
1.4	Recall, describe and apply program-specific engineering principles and concepts	4, 5, 6, 7, 8, 9, 10
2	Problem Analysis	3, 5, 6, 7, 9
2.1	Formulate a problem statement in engineering and non-engineering	3, 5, 6, 7, 9

#	Outcome	Learning Outcome
	terminology	
2.2	Identify, organize and justify appropriate information, including assumptions	3, 5, 6, 7, 9
2.3	Construct a conceptual framework and select an appropriate solution approach	3, 5, 6, 7, 9
2.4	Execute an engineering solution	3, 5, 6, 7, 9
2.5	Critique and appraise solution approach and results	3, 5, 6, 7, 9
5	Use of Engineering Tools	11
5.1	Select appropriate engineering tools from various alternatives	11
5.2	Demonstrate proficiency in the application of selected engineering tools	11
6	Individual & Teamwork	11
6.2	Understand all members' roles and responsibilities within a team	11
7	Communication Skills	11
7.1	Identify key message(s) and intended audience in verbal or written communication as both sender and receiver	11
7.3	Construct the finished elements using accepted norms in English, graphical standards, and engineering conventions, as appropriate for the message and audience	11
7.4	Substantiate claims by building evidence-based arguments and integrating effective figures, tables, equations, and/or references	11
7.5	Demonstrate ability to process oral and written communication by following instructions, actively listening, incorporating feedback, and formulating meaningful questions	11

## 5 Teaching and Learning Activities

### 5.1 Class Schedule

Week	Day	Topic/Event	References	Objectives
1	Thursday	Introduction	Slides	1

<b>2-3</b>	Tuesday Thursday	Background and Fundamentals of Electromagnetism (1) Fundamentals of Electromagnetism (2)	Chapter 1	1, 2
<b>3-4</b>	Tuesday Thursday	Magnetic Materials, Magnetic Circuits	Chapter 1	1, 2, 3
<b>5</b>	Tuesday Thursday	Applications of Electromechanical Devices, Electronic Elements	Chapter 1 and class lectures	2, 3
<b>6</b>	Tuesday Thursday	Transformers Linear DC Machines (1)	Chapter 2 and class lectures	4, 5
<b>7</b>	Thursday	Linear DC Machines (2)	Chapter 1 and class lectures	4
<b>8</b>	Tuesday Thursday	Rotary DC Motors and Generators (1) Rotary DC Motors and Generators (2)	Chapters 7, 8	6, 7
<b>9</b>	Tuesday Thursday	Rotary DC Motors and Generators (3) Speed Control of DC Motors	Chapters 7, 8	6, 7, 8

10	Tuesday Thursday	Three Phase Circuits (1) Three Phase Circuits (2)	Class lectures	9
11	Tuesday Thursday	Concept of Rotating Magnetic Fields (1) Concept of Rotating Magnetic Fields (2)	Chapter 3	9
12	Tuesday Thursday	AC Motors and Generators (1) AC Motors and Generators (2)	Chapters 4	9
13	Tuesday Thursday	AC Motors and Generators, Special Purpose Motors	Chapter 6 and class lectures	9, 10

- **Note:** The chapters mentioned here are only used as a **reference**. The instructor may not necessarily follow exactly the material covered in the chapters. Students are responsible for **whatever is taught** in the class. Furthermore, note that the class schedule may be subject to change. Please refer to the most recent syllabus or outline available

## 5.2 Lab Schedule

Lab reports are due one week after the lab was performed **by 5 pm of the week that you have lab**. Please submit the lab reports on Courselink.

Important Notes:



- **Week 2 starts on Monday, September 9.**
- Introduction to Lab Equipment and Safety Training, and Grouping will be held on the week of September 9. Attendance at this session is **required to pass the course.**
- The first lab will be held on Week 5, or the week of September 30.

<b>Week*</b>	<b>Topic</b>	<b>Report Due</b>
2 (week of Sept. 9)	<b>Introduction to labs, Safety Training, and Grouping</b>	<b>N/A</b>
3 (week of Sept. 16)	Answers to questions about the labs, course, etc.	
4 (week of Sept. 23)	Answers to questions about the labs, course, etc.	
5 (week of Sept. 30)	<b>Lab 1: Faraday's Law OR Transformers</b>	<b>Week 6</b> (week of Oct. 7)
6 (week of Oct. 7)	Answers to questions about the labs, course, etc.	
7* (week of Oct. 14)  (please see note below, on page 10)	<b>Lab 2: Faraday's Law OR Transformers</b>	<b>Week 8</b> (week of Oc. 21)
8 (week of Oc. 21)	Answers to questions about the labs, course, etc.	
9 (week of Oct. 28)	<b>Lab 3: Electromotors OR Energy Conversion</b>	<b>Week 10</b> (week of Nov. 4)

10 (week of Nov. 4)	Answers to questions about the labs, course, etc.	
11 (week of Nov. 11)	<b>Lab 4: Electromotors OR Energy Conversion</b>	<b>Week 12 (week of Nov. 18)</b>
12 (week of Nov. 18)	Answers to questions about the labs, course, etc.	
13 (week of Nov. 25)	Answers to questions about the labs, course, etc.	

\* **Note:** Due to study day, Tuesday Oct. 15 labs will be held on the week of Oct. 22 and the reports will be due Oct. 29.

### 5.3 Tutorial Schedule

There is weekly tutorial. The first tutorial will be held on the week of September 9.

### 5.4 Other Important Dates

**Thursday Sept. 5, 2019:** First day of class

**Monday, October 14, 2019:** Thanksgiving Day, No Classes

**Tuesday, October 15, 2019:** Study Day, No Classes

**Thursday, November 28, 2019:** Make up for Study Day (Tuesday Schedule)

**Friday, November 29, 2019:** Make up for Thanksgiving Day (Monday Schedule) and Last Day to Drop Fall Courses Without Academic Penalty

## 6 Assessments

### 6.1 Assessment Details

#### Labs (25%)

**Learning Outcome:** 11

#### Midterm (35%)

**Date:** Thu, Oct 24, In class

**Learning Outcome:** 1, 2, 3, 4, 5

Important Notes: Exam is closed-book and closed-notes. A formula sheet will be provided

in the exam. Only that formula sheet can be used in the exam. Students are allowed to bring calculators. Use of cell-phones are not allowed during exam.

\* If you miss a test **only due to grounds for granting academic consideration or religious accommodation**, the weight of the missed test will be added to the final exam. There will be no makeup midterm tests.

### **Final Exam (40%)**

**Date:** Fri, Dec 13, 2:30 PM - 4:30 PM, Room TBA on Web advisor

**Learning Outcome:** 1, 2, 3, 6, 7, 8, 9, 10

Final Exam: 02:30PM - 04:30PM (2019/12/13)

Important Notes: Exam is closed-book and closed-notes. A formula sheet will be provided in the exam. Only that formula sheet can be used in the exam. Students are allowed to bring calculators. Use of cell-phones is not allowed during exam.

## **7 Course Statements**

### **7.1 Course Grading Policies**

**Missed Assessments:** If you are unable to meet an in course requirement due to medical, psychological, or compassionate reasons, please email the course instructor. See the undergraduate calendar for information on regulations and procedures for Academic Consideration: <http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08ac.shtml>

**Accommodation of Religious Obligations:** If you are unable to meet an in course requirement due to religious obligations, please email the course instructor at the start of the semester to make alternate arrangements. See the undergraduate calendar for information on regulations and procedures for Academic Accommodation of Religious Obligations: <http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08accomrelig.shtml>

**Passing grade:** In order to pass the course, you must obtain a grade of 50% or higher in total.

**Lab Work:** you must attend and complete all laboratories. If you miss a laboratory due to grounds for granting academic consideration or religious accommodation, arrangements must be made ahead of time with the teaching assistant to complete a makeup lab. If you miss a lab but do not have grounds for consideration (academic or religious), you will get zero

on that lab.

Late Lab Reports: Late submissions of lab reports will not be accepted.

## **8 School of Engineering Statements**

### **8.1 Instructor's Role and Responsibility to Students**

The instructor's role is to develop and deliver course material in ways that facilitate learning for a variety of students. Selected lecture notes will be made available to students on Courselink but these are not intended to be stand-alone course notes. Some written lecture notes will be presented only in class. During lectures, the instructor will expand and explain the content of notes and provide example problems that supplement posted notes. Scheduled classes will be the principal venue to provide information and feedback for tests and labs.

### **8.2 Students' Learning Responsibilities**

Students are expected to take advantage of the learning opportunities provided during lectures and lab sessions. Students, especially those having difficulty with the course content, should also make use of other resources recommended by the instructor. Students who do (or may) fall behind due to illness, work, or extra-curricular activities are advised to keep the instructor informed. This will allow the instructor to recommend extra resources in a timely manner and/or provide consideration if appropriate.

### **8.3 Lab Safety**

Safety is critically important to the School and is the responsibility of all members of the School: faculty, staff and students. As a student in a lab course you are responsible for taking all reasonable safety precautions and following the lab safety rules specific to the lab you are working in. In addition, you are responsible for reporting all safety issues to the laboratory supervisor, GTA or faculty responsible.

## **9 University Statements**

### **9.1 Email Communication**

As per university regulations, all students are required to check their e-mail account regularly: e-mail is the official route of communication between the University and its students.

### **9.2 When You Cannot Meet a Course Requirement**

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. The grounds for Academic Consideration are detailed in the Undergraduate and Graduate Calendars.

Undergraduate Calendar - Academic Consideration and Appeals

<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml>

Graduate Calendar - Grounds for Academic Consideration

<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml>

Associate Diploma Calendar - Academic Consideration, Appeals and Petitions

<https://www.uoguelph.ca/registrar/calendars/diploma/current/index.shtml>

### 9.3 Drop Date

Students will have until the last day of classes to drop courses without academic penalty. The deadline to drop two-semester courses will be the last day of classes in the second semester. This applies to all students (undergraduate, graduate and diploma) except for Doctor of Veterinary Medicine and Associate Diploma in Veterinary Technology (conventional and alternative delivery) students. The regulations and procedures for course registration are available in their respective Academic Calendars.

Undergraduate Calendar - Dropping Courses

<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml>

Graduate Calendar - Registration Changes

<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/genreg-reg-regchg.shtml>

Associate Diploma Calendar - Dropping Courses

<https://www.uoguelph.ca/registrar/calendars/diploma/current/c08/c08-drop.shtml>

### 9.4 Copies of Out-of-class Assignments

Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

### 9.5 Accessibility

The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.

When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is required; however, interim accommodations may be possible while that process is underway.

Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not constitute a disability.

Use of the SAS Exam Centre requires students to book their exams at least 7 days in advance and not later than the 40th Class Day.

For Guelph students, information can be found on the SAS website  
<https://www.uoguelph.ca/sas>

For Ridgetown students, information can be found on the Ridgetown SAS website  
<https://www.ridgetownc.com/services/accessibilityservices.cfm>

## 9.6 Academic Integrity

The University of Guelph is committed to upholding the highest standards of academic integrity, and it is the responsibility of all members of the University community-faculty, staff, and students-to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff, and students have the responsibility of supporting an environment that encourages academic integrity. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

Undergraduate Calendar - Academic Misconduct  
<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml>

Graduate Calendar - Academic Misconduct  
<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml>

## 9.7 Recording of Materials

Presentations that are made in relation to course work - including lectures - cannot be recorded or copied without the permission of the presenter, whether the instructor, a student, or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

## 9.8 Resources

The Academic Calendars are the source of information about the University of Guelph's procedures, policies, and regulations that apply to undergraduate, graduate, and diploma programs.

Academic Calendars  
<https://www.uoguelph.ca/academics/calendars>