



# ENGG\*3510 Electromechanical Devices

01

Fall 2023

Section(s): C01

School of Engineering

Credit Weight: 0.50

Version 1.00 - September 07, 2023

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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

**Restrictions:** Non-BENG students may take a maximum of 4.00 ENGG credits.

### 1.2 Timetable

**Lectures:**

Tuesday	1:00 PM – 2:20 PM	RICH 2529
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Thursday	1:00 PM – 2:20 PM	RICH 2529
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**Labs (will be announced on CourseLink):**

Monday	Sec 41,42, 43	2:30 PM- 4:20 PM	THRN 1008
	Sec 51, 52, 53	12:30 PM-2:20 PM	THRN 1008
Tuesday	Sec 21, 22, 23	2:30 PM-4:20 PM	THRN 1008
Wednesday	Sec 31, 32, 33	2:30 PM - 4:20 PM	THRN 1008
Friday	Sec 11, 12, 13	12: 30 PM -2:20 PM	THRN 1008

**Weekly tutorial (will be announced on CourseLink):**

Monday	Sec 11, 21,31,41, 51	07:00 PM - 07:50 PM	ANNU 204
Tuesday	Sec 12, 22,32,42, 52	07:00 PM - 07:50 PM	MCKN 238
Wednesday	Sec 13, 23,33,43,53	07:00 PM -07:50 PM	MCKN 233

## 1.3 Final Exam

Date and Location: TBA on WebAdvisor

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

## 2 Instructional Support

### 2.1 Instructional Support Team

**Instructor:** Jhantu Kumar Saha Ph.D., EIT  
**Email:** jsaha@uoguelph.ca

<b>Telephone:</b>	+1-519-824-4120 x53385
<b>Office:</b>	THRN 2361
<b>Office Hours:</b>	TBA on CourseLink or By Appointment
<b>Lab Technician:</b>	Barry Verspagen
<b>Email:</b>	baverspa@uoguelph.ca
<b>Telephone:</b>	+1-519-824-4120 x58821
<b>Office:</b>	THRN 1138
<b>Office Hours:</b>	TBA on CourseLink or By Appointment

## 2.2 Teaching Assistants

<b>Teaching Assistant (GTA):</b>	Talib Al-Hasani
<b>Email:</b>	talhasan@uoguelph.ca
<b>Office Hours:</b>	TBA on CourseLink or By Appointment
<b>Teaching Assistant (GTA):</b>	Aneri Kanaiyabhai Patel
<b>Email:</b>	anerikan@uoguelph.ca
<b>Office Hours:</b>	TBA on CourseLink or By Appointment
<b>Teaching Assistant (GTA):</b>	Ambegaonkar Suchit
<b>Email:</b>	sambegao@uoguelph.ca
<b>Office Hours:</b>	TBA on CourseLink or By Appointment

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## 3 Learning Resources

### 3.1 Required Resources

#### Course Website (Website)

<http://courselink.uoguelph.ca>

Since the course will be handled online, it is very important and essential for the students to check ENGG\*3510 CourseLink very frequently. Course material, news, announcements, deadlines (for assignments), grades, etc. will be posted on the ENGG\*3510 CourseLink.

**Students are responsible for checking CourseLink (for ENGG\*3510) 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)**

#### Textbook:

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

“Principles and Applications of Electrical Engineering”, by G. Rizzoni, McGraw-Hill, 5th edition, 2007

\* Purchase of the textbook is optional.

## 3.2 Additional Resources

### Lecture Information (Notes)

**Some parts** of the lectures are posted on the CourseLink. The reason that only some parts are posted is to ensure that students attend the classes to learn the material. Note that the posted lectures on the CourseLink **may NOT** have all of the material taught in the class. Students should attend the classes and make their own notes. Only lecture notes will be posted on CourseLink after each class.

### Assignments and project (Notes)

Assignments and their due dates will be posted on the CourseLink. Submission is also on the Dropbox (of the CourseLink).

### Miscellaneous Information (Other)

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

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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 terminology	3, 5, 6, 7, 9
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

#	Outcome	Learning Outcome
2.5	Critique and appraise solution approach and results	3, 5, 6, 7, 9
3	Investigation	11
3.3	Analyze and interpret experimental data	11
3.4	Assess validity of conclusions within limitations of data and methodologies	11
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

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. There will be regular quizzes throughout the course as per the schedule.

### 5.1 Class Schedule

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

Background and Fundamentals of  
Electromagnetism (1)

<b>2</b>	Tuesday Thursday	Background and Fundamentals of Electromagnetism (2)	Slides	1
<b>3</b>	Tuesday Thursday	Magnetic Materials, Magnetic Circuits	Chapter 18, and Slides	1, 2
<b>4</b>	Tuesday Thursday	Magnetic Materials, Magnetic Circuits	Chapter 18, and Slides	1, 2, 3
		Applications of Electromechanical Devices, Electronic Elements		
		<b>Quiz #1 (Thursday, Sept. 28, 2023 in class)</b>		
<b>5</b>	Tuesday Thursday	Transformers	Chapter 2, Slides, and class lectures	3, 4, 5
<b>6</b>	Thursday	Transformers  Linear DC Machines (1)	Chapter 2, 7, 8 and Slides, class lectures	3, 4, 5, 6
<b>7</b>	Tuesday Thursday	Linear DC Machines (2)	Chapter 7 and class lectures	6
		<b>Quiz #2 (Thursday, October 19, 2023 in class)</b>		
<b>8</b>	Tuesday Thursday	Rotary DC Motors and Generators (1)	Chapters 7, 8, 19	7, 8

**Quiz # 3 (Thursday, Oct. 26, 2023  
in class)**

**9** Tuesday  
Thursday Rotary DC Motors and Generators Chapters 7, 8,19 6, 7, 8  
(2)

Rotary DC Motors and Generators  
(3)

Speed Control of DC Motors

**10** Tuesday  
Thursday Three Phase Circuits Class lectures 9

**Quiz #4 (Thursday, Nov. 9, 2023 in  
class)**

**11** Tuesday  
Thursday Concept of Rotating Magnetic Fields (1) Chapter 3,Slides 9

**Quiz #5 (Thursday, Nov. 16, 2023  
in class)**

**12** Tuesday  
Thursday Concept of Rotating Magnetic Fields (2) Chapters 8, Slides 9

AC Motors and Generators (1)

AC Motors and Generators (2)

**13** Tuesday  
Thursday AC Motors and Generators, Special Purpose Motors Chapter 3, 20 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 Labs

Lab reports are due two weeks after the lab was performed **by 5 pm of the week that you have lab**. Please submit them in the **Dropbox**.

### Important Notes:

- Week 4 starts on Monday, September 25.
- Introduction to Lab Equipment and Safety Training, and Grouping will be held on the week of September 18. Attendance at this session is **required to pass the course**.
- The first lab will be held on the week of September 25.

Week*	Topic	Due
2	Answers & questions about the course, labs, material	N/A
3	<b>Introduction to Lab Equipment and Safety Training, and Grouping</b>	N/A
4	<b>Lab 1: Faraday's Law</b>	Lab 1 Report Due: Week of Oct. 9
5	<b>Lab 2: Transformers and Magnetic Circuits</b>	Lab 2 Report Due: Week of Oct. 16
6	Answers to questions about the course, labs, material	N/A
7	Answers to questions about the course, labs, material	N/A
8	<b>Lab 3: Generators and Energy Transfer</b>	Lab 3 Report Due: Week of Nov. 6

9	Answers to questions about the course, labs, tutorials material	<b>N/A</b>
10	<b>Lab 4: Electromotors</b>	Lab 4 Report Due: Week of Nov. 20
11	Answers to questions about the course, labs, material, other presentations	<b>N/A</b>
12	Answers to questions about the course, labs, material, other presentations	<b>N/A</b>

\* **Note** (as stated also above): Week 2 starts on Monday, September 11.

Late policy: for every late date 10% mark of that report will be deducted for every 12 hours.

Furthermore, note that the lab schedule may be subject to change. Please refer to the most recent lab available.

### 5.3 Other Important Dates

Thursday, September 07, 2023: First day of class

Monday, October 9, 2023: Thanksgiving holiday

Tuesday, October 10, 2023: Fall study day, no classes

Friday, November 3: 40th class day

Wednesday, November 29, 2023: last day of class

**Thursday, November 30, 2023:** Make up for Study Day (Tuesday Oct 10 re-scheduled)

**Friday, December 1, 2023:** Make up for Thanksgiving Day (Monday Oct 9 re-scheduled) and Last day to drop one-semester courses

## 6 Assessments

### 6.1 Assessment Details

#### Labs (30%)

**Learning Outcome:** 11

See Lab section above for dates

#### Quizzes (35%)

**Date:** See Class schedule section above for dates, In class

**Learning Outcome:** 1, 2, 3, 5, 6, 7

**Quizzes:** If you miss a quiz, you will be assigned a grade of **0** for that quiz. There will be **5** quizzes in total, and if you miss a quiz due to grounds of academic, religious considerations, the weight of your missed quiz will be added to your final exam. **There will be no makeup quizzes.**

#### Final Exam (35%)

**Due:** , TBA on Web Advisor

**Learning Outcome:** 1, 2, 3, 5, 6, 7, 8, 9, 10

**Important Note Regarding Exams:** Exam is closed-book and closed-notes. For exams you are allowed to bring your own **one-page** aid sheet (double-sided) letter size, A4 size (8.3 "x 11.7 ") that can **only have formulas** (No solved problems, no derivations, no descriptions, no examples, no explanations, no figures, no diagrams, no graphs, no curves, no tables, no units etc.). Formulas only. **Any deviations from this** will result in a 40% **deduction** of your exam mark. 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.

**Important Note:** While you are encouraged to discuss with other classmates on problems in the class or labs, there is zero tolerance for plagiarism or copying. A grade of 0% will be assigned to any quiz or lab report if it is copied or plagiarized by any means.

## 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 make a booking at least 14 days in advance, and no later than November 1 (fall), March 1 (winter) or July 1 (summer). Similarly, new or changed accommodations for online quizzes, tests and exams must be approved at least a week ahead of time.

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>

## 9.9 Illness

Medical notes will not normally be required for singular instances of academic consideration, although students may be required to provide supporting documentation for multiple missed assessments or when involving a large part of a course (e.g.. final exam or major assignment).

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