



ENGG*3510 Electromechanical Devices

01

Fall 2022

Section(s): C01

School of Engineering

Credit Weight: 0.50

Version 1.00 - October 03, 2022

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

Lectures:

Monday	12:30 PM – 1:20 PM	MCKN 117
Tuesday	12:30 PM – 1:20 PM	MCKN 117
Wednesday	12:30 PM- 1:20 PM	MCKN 117

Weekly tutorial (will be announced on CourseLink):

Monday	Sec 13, 23,33,43, 53	07:00 PM - 07:50 PM	ALEX 028
Tuesday	Sec 12, 22,32,42, 52	07:00 PM - 07:50 PM	ALEX 028
Wednesday	Sec 11, 21,31,41,51	07:00 PM -07:50 PM	ALEX 028

Labs (will be announced on CourseLink):

Monday	Sec 21,22, 23	10:30 AM- 12:20 PM	THRN 1008
Tuesday	Sec 31, 32, 33	10:30 AM-12:20 PM	THRN 1008
	Sec 11, 12, 13	03:30 PM-05:20 PM	THRN 1008
Thursday	Sec 41, 42, 43	10:30 AM - 12:20 PM	THRN 1008
	Sec 51, 52, 53	12:30 PM -2:20 PM	THRN 1008

1.3 Final Exam

December 15, 2022

Thursday 11:30 AM - 1:30 PM

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
Telephone: +1-519-824-4120 x53385
Office: THRN 2361
Office Hours: TBA on CourseLink or By Appointment

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

2.2 Teaching Assistants

Teaching Assistant (GTA): Talib Al-Hasani
Email: talhasan@uoguelph.ca
Office Hours: TBA on CourseLink or By Appointment

Teaching Assistant (GTA): Shubham Mendpara
Email: smendpar@uoguelph.ca
Office Hours: TBA on CourseLink or By Appointment

Teaching Assistant (GTA): Jay Shah
Email: jshah06@uoguelph.ca
Office Hours: TBA on CourseLink or By Appointment

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.

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

#	Outcome	Learning Outcome
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
0	Friday	Introduction		1
1	Monday	Introduction	Slides	1

	Wednesday	Background and Fundamentals of Electromagnetism (1)		
	Friday			
2	Monday	Fundamentals of Electromagnetism (2)	Chapter 18, and Slides	1, 2
	Wednesday			
	Friday			
3	Monday	Magnetic Materials, Magnetic Circuits	Chapter 18, and Slides	1, 2, 3
	Wednesday			
	Friday			
4	Monday	Applications of Electromechanical Devices, Electronic Elements	Chapter 18, and Slides	2, 3
	Wednesday			
	Friday			
5	Monday	Holiday	Chapter 5 and class lectures	4, 5
	Wednesday	Transformers		
	Friday	Linear DC Machines (1)		
6	Monday	Linear DC Machines (2)	Chapter 5 and class lectures	4
	Wednesday	Mid-term (Oct. 21 in Class)		
	Friday			
7	Monday	Rotary DC Motors and Generators (1)	Chapters 7, 8,19	6, 7
	Wednesday	Rotary DC Motors and Generators (2)		

	Wednesday			
8	Monday	Rotary DC Motors and Generators (3) Speed Control of DC Motors	Chapters 7, 8,19	6, 7, 8
	Wednesday			
	Friday			
9	Monday	Three Phase Circuits (1) Three Phase Circuits (2)	Class lectures	9
	Wednesday			
	Friday			
10	Monday	Concept of Rotating Magnetic Fields (1) Concept of Rotating Magnetic Fields (2)	Chapter 3,Slides	9
	Wednesday			
	Friday			
11	Monday	AC Motors and Generators (1) AC Motors and Generators (2)	Chapters 8, Slides	9
	Wednesday			
	Friday			
12	Monday	AC Motors and Generators, Special Purpose Motors	Chapter 8 and class lectures	9, 10
	Wednesday			
	Friday			

- **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 one week 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, October 3.
- Introduction to Lab Equipment and Safety Training, and Grouping will be held on the week of September 26. Attendance at this session is **required to pass the course**.
- The first lab will be held on the week of October 3.

Week*	Topic	Due
2	Answers & questions about the course, labs, material	N/A
3	Introduction to Lab Equipment and Safety Training, and Grouping	N/A
4	Lab 1: Faraday's Law	Lab 1 Report Due: Week of Oct. 10
5	Answers & questions about the course, labs, material	N/A
6	Lab 2: Transformers	Lab 2 Report Due: Week of Oct. 31
7	Answers to questions about the course, labs, material	N/A
8	Lab 3: Electromotors	Lab 3 Report Due: Week of Nov. 7
9	Answers to questions about the course, labs, tutorials material	N/A
10	Lab 4: Energy Conversion	Lab 4 Report Due: Week of Nov. 21
11	Lab 4: Motor Control	N/A
12	Answers to questions about the course, labs, material, other	N/A

presentations

* **Note** (as stated also above): Week 1 starts on Monday, September 12.

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

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

Due to Thanksgiving day and study day, Monday Oct. 10 and Tuesday Oct. 11 lab 1 report will be due on Oct. 14.

5.3 Weekly Tutorials

Tutorials will be held throughout the semester, and will be announced on CourseLink and in class.

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

Week* Topic

1	Answers to questions about the course, labs, tutorials material
2	Tutorial 1: Review and Background
3	Tutorial 2: Magnetic Circuits
4	Tutorial 3: Magnetic Circuits
5	Tutorial 4: Transformers
6	Answers to questions about the course, labs, tutorials material
7	Tutorial 5: Linear DC Machines
8	Tutorial 6: Rotary DC Machines (Motors)

9	Tutorial 7: Rotary DC Machines P.II (Motors and Generators)
10	Tutorial 8: Single Phase Review
11	Answers to questions about the course, labs, material, other presentations
12	Answers to questions about the course, labs, material, other presentations

5.4 Other Important Dates

Thursday, September 09, 2022: First day of class

Monday, October 10, 2022: Thanksgiving holiday

Tuesday, October 11, 2022: Fall study day, no classes

Wednesday, November 30, 2022: last day of class

Thursday, December 1, 2022: Make up for Study Day (Tuesday Oct 11 re-scheduled)

Friday, December 2, 2022: Make up for Thanksgiving Day (Monday Oct 10 re-scheduled) and Last day to drop one-semester courses

6 Assessments

6.1 Assessment Details

Labs (25%)

Learning Outcome: 11

See Lab section above for dates

Midterm (35%)

Date: Fri, Oct 21, In class

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

* 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.

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.

Final Exam (40%)

Due: Thu, Dec 15, 8:30 AM - 10:30 AM

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

Important Note Regarding Exams:

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.

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/c08/accomrelig.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 Disclaimer

Please note that the ongoing COVID-19 pandemic may necessitate a revision of the format of course offerings, changes in classroom protocols, and academic schedules. Any such changes will be announced via CourseLink and/or class email.

This includes on-campus scheduling during the semester, mid-terms and final examination schedules. All University-wide decisions will be posted on the COVID-19 website (<https://news.uoguelph.ca/2019-novel-coronavirus-information/>) and circulated by email.

9.10 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).

9.11 Covid-19 Safety Protocols

For information on current safety protocols, follow these links:

- <https://news.uoguelph.ca/return-to-campus/how-u-of-g-is-preparing-for-your-safe-return/>
- <https://news.uoguelph.ca/return-to-campus/spaces/#ClassroomSpaces>

Please note, these guidelines may be updated as required in response to evolving University,

Public Health or government directives.
