

ENGG*3510 Electromechanical Devices

Fall 2016



[School of Engineering](#)

(Revision 3: August 30, 2016)

1 INSTRUCTIONAL SUPPORT

1.1 Instructor

Instructor: S. Andrew Gadsden, Ph.D., P.Eng., P.M.P.

Office: THRN 2411, ext. 52431

Email: gadsden at uoguelph.ca

Office hours: By appointment

1.2 Lab Technician

Technician: Barry Verspagen

Office: THRN 1175, ext. 58821

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1.3 Teaching Assistants

GTA	Email	Office Hours
Mohammadali Shahriari	mshahria at uoguelph.ca	TBA
Negin Lashkari	nlashkar at uoguelph.ca	TBA
Ahmed Elsaftawy	elsaftaa at uoguelph.ca	TBA
Rida Anjum	ranjum at uoguelph.ca	TBA

2 LEARNING RESOURCES

2.1 Course Website

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

2.2 Required Resources

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. The textbook for the course is available at the bookstore and is selected chapters from the following sources:

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

(we only cover chapters 18-20)

2. "Electric Machinery Fundamental", by S. J. Chapman, McGraw-Hill, 5th edition, 2011

(we only cover chapters 8-10)

* Purchase of the textbook is optional.

2.3 Recommended Resources

No additional resources recommended.

2.4 Additional Resources

Lecture Information: **Some parts** of the lectures notes are posted on the web page. 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 webpage **may NOT** have all of the material taught in the class. Students should attend the classes and make their own notes.

Lab Information: The handouts for all the lab sessions are within the lab section. All types of resources regarding tutorials, links to web pages can be found in this section.

Assignments: None!

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

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

2.5 Communication & Email Policy

Please use lectures and lab help sessions as your main opportunity to ask questions about the course. Major announcements will be posted to the course website. **It is your responsibility to check the course website regularly.** As per university regulations, all students are required to check their <mail.uoguelph.ca> e-mail account regularly: e-mail is the official route of communication between the University and its students.

3 ASSESSMENT

3.1 Dates and Distribution

Labs: 30%

See section 5.3 below for dates

Quizzes: 35%

See section 5.2 below for dates

Final Exam: 35%

Tuesday, Dec 6, 2016, 7:00 pm – 9:00 pm, Room TBA on Webadvisor

Important Note Regarding Exams: 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.

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.

3.2 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/c08-ac.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.

Quizzes: If you miss a quiz, you will be assigned a grade of 0 for that quiz. There will be 11 quizzes in total, and your top 7 quiz grades will be used towards your final grade. **There will be no makeup quizzes.**

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.

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

4 AIMS, OBJECTIVES & GRADUATE ATTRIBUTES

4.1 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.

Prerequisite(s): ENGG*2450, PHYS*1010

4.2 Course Aims

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.

4.3 Learning Objectives

At the successful completion of this course, the student will have demonstrated the ability 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, Zener Diode, and Transistors and their applications
5. Analyze transformers and utilize the knowledge of magnetic circuits to be able to analyze them. Design of simple transformers.
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.

4.4 Graduate Attributes

Successfully completing this course will contribute to the following CEAB Graduate Attributes:

Graduate Attribute	Learning Objectives	Assessment
1. Knowledge Base for Engineering	1, 2, 5, 6	Exams, Quizzes
2. Problem Analysis	2,3,5,6,7,8,9,10	Exams, Quizzes
3. Investigation	11	Labs
4. Design	3, 5, 6	Exams, Quizzes
5. Use of Engineering Tools	-	Labs, Quizzes
6. Communication	11	Labs
7. Individual and Teamwork	-	Labs
8. Professionalism	-	-
9. Impact of Engineering on Society and the Environment	-	-
10. Ethics and Equity	-	Labs
11. Environment, Society, Business, & Project Management	-	-
12. Life-Long Learning	1,2,3,5,6,10,11	-

4.5 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/D2L but these are not intended to be stand-alone course notes. 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 quizzes and examination(s).

4.6 Students' Learning Responsibilities

Students are expected to take advantage of the learning opportunities provided during lectures and tutorials. 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.

4.7 Relationships with other Courses & Labs

Previous Courses:

ENGG*2450: Fundamentals of DC and AC circuits, KVL, KLC

PHYS*1010: Fundamental laws of electromagnetism

Follow-on Courses:

ENGG*3490: Introduction to Mechatronics System Design

ENGG*4030: Manufacturing System Design

ENGG*4480: Advanced Mechatronic Systems Design

5 TEACHING AND LEARNING ACTIVITIES

5.1 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 Thursday tutorial from 19:00 – 19:50.

Lectures:

Monday			13:30 – 14:20	RICH 2520
Wednesday			13:30 – 14:20	RICH 2520
Friday			13:30 – 14:20	RICH 2520

Labs:

Monday	Sec	41, 42, 43	10:30 – 12:20	THRN 1007
Monday	Sec	71, 72, 73	15:30 – 17:20	THRN 1007
Tuesday	Sec	31, 32, 33	10:30 – 12:20	THRN 1007
Tuesday	Sec	21, 22, 23	13:30 – 15:20	THRN 1007
Wednesday	Sec	51, 52, 53	10:30 – 12:20	THRN 1007
Thursday	Sec	11, 12, 13	10:30 – 12:20	THRN 1007
Friday	Sec	61, 62, 63	13:30 – 15:20	THRN 1007

Tutorials (will be announced):

Wednesday	Sec	11, 21, 31, 41, 51, 61	19:00 – 19:20	MCKN 224
Thursday	Sec	12, 22, 32, 42, 52, 62	19:00 – 19:20	MCKN 226
Thursday	Sec	13, 23, 33, 43, 53, 63	19:00 – 19:20	MCKN 224

5.2 Class Schedule

Week	Day	Topic/Event	References	Objectives
1 (09/05)	Friday	Introduction	Slides	1
2 (09/12)	Monday Wednesday Friday	Background and Fundamentals of Electromagnetism (1) Fundamentals of Electromagnetism (2) Quiz #1	Chapter 18, Slides	1, 2
3 (09/19)	Monday Wednesday Friday	Magnetic Materials Magnetic Circuits Quiz #2	Chapter 18, Slides	1, 2, 3
4 (09/26)	Monday Wednesday Friday	Applications of Electromechanical Devices Electronic Elements Quiz #3	Chapter 18, Slides	2, 3
5 (10/03)	Monday Wednesday Friday	Transformers Linear DC Machines (1) Quiz #4	Chapter 5, Slides	4, 5
6 (10/10)	Monday Wednesday Friday	No Class (Turkey Day) Linear DC Machines (2) Quiz #5	Chapter 5, Slides	4
7 (10/17)	Monday Wednesday Friday	Rotary DC Motors and Generators (1) Rotary DC Motors and Generators (2) Quiz #6	Chapters 7, 19	6, 7
8 (10/24)	Monday Wednesday Friday	Rotary DC Motors and Generators (3) Speed Control of DC Motors Quiz #7	Chapters 7, 19	6, 7, 8
9 (10/31)	Monday Wednesday Friday	Three Phase Circuits (1) Three Phase Circuits (2) Quiz #8	Slides	9
10 (11/07)	Monday Wednesday Friday	Concept of Rotating Magnetic Fields (1) Concept of Rotating Magnetic Fields (2) Quiz #9	Chapter 3, Slides	9
11 (11/14)	Monday Wednesday Friday	AC Motors and Generators (1) AC Motors and Generators (2) Quiz #10	Chapter 8, Slides	9
12 (11/21)	Monday Wednesday Friday	AC Motors and Generators (3) Special Purpose Motors Quiz #11	Chapter 8, Slides	9, 10
13 (11/28)	Monday Wednesday Friday	Review of Material (1) Review of Material (2) Practice Exam	All	1
14 (12/05)	Tuesday	Final Exam	All	1

* **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 online.

5.3 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 them in the metal Dropbox #9 located beside the SOE machine shop.

Important Notes:

- Week 2 starts on Monday, September 12. For example, Week 5 starts on Monday, October 3.
- Introduction to Lab Equipment and Safety Training, and Grouping will be held on the week of September 12. 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	Introduction to Lab Equipment and Safety Training, and Grouping	N/A
3	Answers to questions about the course, labs, material	
4	Answers to questions about the course, labs, material	
5	Lab 1: Faraday's Law OR Transformers	Week 6
6	Answers & questions about the course, labs, material	
7	Lab 2: Faraday's Law OR Transformers	Week 8
8	Answers to questions about the course, labs, material	
9	Answers to questions about the course, labs, material	
10	Lab 3: Electromotors OR Energy Conversion	Week 11
11	Lab 4: Electromotors OR Energy Conversion	Week 12
12	Lab 5: Motor Control	N/A
13	Answers to questions about the course, labs, material, other presentations	

* **Note** (as stated also above): Week 1 starts on Monday, September 5.

5.4 Tutorial Schedule

- Tutorials will be held throughout the semester, and will be announced online and in class.

5.5 Other Important Dates

First day of class: Friday, September 9, 2016

Thanksgiving: Monday, October 10, 2016 - no class

Fall Study day: Tuesday, October 11, 2016 - no classes

Last day to drop: Friday, November 4, 2016

Last day of class: Friday, December 2, 2016

6 LAB SAFETY

Safety is critically important to the School and it 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.

1. You should download and print a copy of the corresponding ENGG*3510 Lab Manual from Courselink. Be sure to carefully read the specific manual section before you go to perform each of the laboratory exercises.
2. You must do as instructed by the TA or the technician. If you are not sure about something, ask them. Inform the TA or the technician immediately if you become aware of a potential hazard.
3. Food and beverages cannot be stored or consumed in this laboratory.
4. Safety glasses are mandatory for all experiments. You will not be allowed to perform an experiment without them.
5. Proper footwear is mandatory for all the experiments. This means no open toed shoes or sandals.
6. The fire extinguisher, first aid kit, and phone are located at the front of the lab. Dial ext. 52000 in case of emergencies.
7. All accidents should be reported to the demonstrator.

7 ACADEMIC MISCONDUCT

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 discourages misconduct. 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.

7.1 Resources

The Academic Misconduct Policy is detailed in the Undergraduate Calendar:

<http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml>

A tutorial on Academic Misconduct produced by the Learning Commons can be found at:

<http://www.academicintegrity.uoguelph.ca/>

Please also review the section on Academic Misconduct in your [Engineering Program Guide](#).

The School of Engineering has adopted a Code of Ethics that can be found at:

<http://www.uoguelph.ca/engineering/undergrad-counselling-ethics>

8 ACCESSIBILITY

The University of Guelph is committed to creating a barrier-free environment. Providing services for students is a shared responsibility among students, faculty and administrators. This relationship is based on respect of individual rights, the dignity of the individual and the University community's shared commitment to an open and supportive learning environment. Students requiring service or accommodation, whether due to an identified, ongoing disability for a short-term disability should contact the Centre for Students with Disabilities as soon as possible.

For more information, contact CSD at [519-824-4120](tel:519-824-4120) ext. 56208 or email csd@uoguelph.ca or see the website: <http://www.uoguelph.ca/csd/>

9 RECORDING OF MATERIALS

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

10 RESOURCES

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

<http://www.uoguelph.ca/registrar/calendars/index.cfm?index>