

Western University
Faculty of Engineering
Mechatronic Systems Engineering Program

MSE 3310A/B—Electric Motors and Drives
Course Outline 2023-24

Description:

Overview of the fundamental principles related to the operation of DC and AC motors, the associated power electronic converters and drives. Emphasis will be placed on the design and integration of these devices into mechatronic systems.

Academic Calendar Copy:

Overview of the fundamental principles related to the operation of DC and AC motors, the associated power electronic converters and drives. Emphasis will be placed on the design and integration of these devices into mechatronic systems.

Contact Hours: 3 lecture hours, 3 laboratory hours (7 labs of 3 hours each + project), 0.5 course.

Antirequisite: ECE 3332A/B, ECE 4457A/B

Prerequisites: MSE 2201A/B, MSE 2233A/B

Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you will be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

CEAB Academic Units: Engineering Science 75%, Engineering Design 25%

Recommended Textbooks:

- Hughes, *Electric Motors and Drives: Fundamentals, Types and Applications*, 5th ed. Newnes, 2019

Required Software: MATLAB/Simulink

Recommended References:

- S. J. Chapman, *Electric Machinery Fundamentals*, 5th ed., McGraw-Hill, 2012
- R. Krishnan, *Electric Motor Drives: Modelling, Analysis and Control*, Pearson, 2001
- P.C. Sen, *Principles of Electric Machines and Power Electronics*, 3rd ed., Wiley, 2013
- T. Wildi, *Electrical Machines, Drives and Power Systems*, 6th edition, Pearson, 2005

- N. Mohan, *Advanced Electric Drives: Analysis, Control, and Modeling Using Simulink*, Wiley, 2014

General Learning Objectives: (CEAB Graduate Attributes)

Knowledge Base	D	Use of Engineering Tools	A	Impact on Society and the Environment	
Problem Analysis	D	Individual and Team Work	A	Ethics and Equity	
Investigation	D	Communication Skills		Economics and Project Management	
Design	D	Professionalism		Life-Long Learning	

Notation: *x* represents the content level code as defined by the CEAB. blank = not applicable; I = introduced (introductory); D = developed (intermediate) and A = applied (advanced).

Course Topics and Specific Learning Outcomes	Incorporated GA Indicators
<p>1. Power electronics converters At the end of this section, students will be able to:</p> <ul style="list-style-type: none"> a. Explain the basic principles of operation of power electronics converters. b. Analyze and solve problems related to power electronics converters. 	<p>KB 4</p> <p>PA 3, I 3</p>
<p>2. Electromechanical energy conversion At the end of this section, students will be able to:</p> <ul style="list-style-type: none"> a. Explain the basic principles of the electromechanical energy conversion related to electric machines. 	<p>KB 4</p>
<p>3. Electrical machines At the end of this section, students will be able to:</p> <ul style="list-style-type: none"> a. Explain the electrical machines structure and their operation. b. Analyze and solve problems related to induction machines, conventional DC machines, brushless DC and stepper motors. 	<p>KB 4</p> <p>PA 3, I 3</p>
<p>4. Electrical machine drives At the end of this section, students will be able to:</p> <ul style="list-style-type: none"> a. Describe the commonly used electrical machine drive operation basics. b. Identify the proper method to drive an electrical machine. c. Design and simulate a drive for an electrical machine. 	<p>KB 4</p> <p>PA 3</p> <p>D 3, ET 1</p>

ITW1 and ITW2 will be assessed through the labs associated with each of these topics.

Evaluation:

Course Component	Weight
Laboratory	20%
Project	15%
Midterm	15%
Final Examination	50%

Homework Assignments:

- Assignments provide important information that complements the learning experience and enriches the student's understanding of each topic. There will be up to three homework assignments. All assignments will be available on OWL but they will not be marked or be part of your course evaluation. Selected answers will be discussed in class.

Laboratory:

- It is mandatory for all students to attend all lab sessions. Absence from any session without permission will result in a zero assigned to the corresponding laboratory report.
- Students are only permitted to work on lab exercises during their registered lab section unless special permission to attend an alternate lab section is given by the instructor.
- All work submitted must be clean, readable and organized. Failing one of these criteria, the report will be returned to the student for resubmission and the late submission penalty will take effect. An additional penalty of 10% may be deducted for poor grammar, incoherence or lack of flow in the written reports.
- Lab reports are to be handed in at the end of the laboratory period or when indicated by the instructor.
- All lab reports will be submitted online through the course website on OWL.
- Seven laboratory exercises are scheduled for the term, covering the following topics.
 1. AC-DC diode converters
 2. AC-DC thyristor converters
 3. DC-AC converters
 4. Induction motors
 5. BLDC motors
 6. Brushed DC motors
 7. Stepper motors

Project: A project will be completed in which students will explore a motor drive design and simulation process. The details of the project will be distributed in the class.

Midterm: A midterm test will be scheduled during class time. The date, time, and material to be covered will be announced in class.

Final Examination: The final examination will take place during the regular examination period. The exam will cover all of the material covered in class and in the labs. The final exam will be

three hours long, closed book, and only non-programmable calculators are allowed. A total of 3 hours will be assigned for the completion of the exam.

Course Policies: The following course-specific policies will be enforced throughout the course:

- Late submissions will be penalized 10% per weekday (applied at the due time and cumulative on a daily basis).
- Submissions will not be accepted after 7 days.
- Completing all laboratory sessions is mandatory.
- A minimum mark of 50% in each laboratory exercise is required to pass the course.
- The default assumption is that everyone contributes equally to the team effort, and hence all students will receive the same grade for group assessments.
- Each student will be asked to specify the contribution made by each member of the team, including his/herself.
- Team grades may be adjusted by up to 30% for each student based on self and peer evaluation.
- A minimum of 50% must be obtained on the project in order to pass the course.
- To obtain a passing grade in the course, a mark of 50% or more must be achieved on the final examination. A final examination mark < 50% will result in a final course grade of 48% or less.
- If the above conditions are not met, the final grade cannot be greater than 48%. Students who have failed this course (i.e., final average < 50%) must repeat all course components.

In the event of a COVID-19 resurgence during the course that necessitates the course delivery moving away from face-to-face interaction, all remaining course content will be delivered entirely online, either synchronously (i.e., at the times indicated in the timetable) or asynchronously (e.g., posted on OWL for students to view at their convenience). The grading scheme will not change. Any remaining assessments will also be conducted online at the discretion of the course instructor”

Use of English: In accordance with Senate and Faculty Policy, students may be penalized up to 10% of the marks on all assignments, tests, and examinations for improper use of English. Additionally, poorly written work, with the exception of the final examination, may be returned without grading. If resubmission of the work is permitted, it may be graded with marks deducted for poor English and/or late submission.

Attendance: All classes, laboratories, and tutorials are mandatory unless otherwise stated. Any student who, in the opinion of the instructor, is absent too frequently from class, laboratory, or tutorial periods will be reported to the Dean (after due warning has been given). On the recommendation of the program, and with the permission of the Dean, the student will be debarred from taking the regular final examination in the course.

Absence Due to Illness or Other Circumstances: Students should immediately consult with the instructor or program Director if they have any problems that could affect their performance in the course. Where appropriate, the problems should be documented (see the attached “Instructions for Students Unable to Write Tests or Examinations or Submit Assignments as Scheduled”). The student should seek advice from the instructor or program Director regarding how best to deal with

the problem. Failure to notify the instructor or program Director immediately (or as soon as possible thereafter) will have a negative effect on any appeal.

For more information concerning medical accommodations, see the relevant section of the Academic Handbook:

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_medical.pdf

For more information concerning accommodations for religious holidays, see the relevant section of the Academic Handbook:

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_religious.pdf

Missed Midterm Examinations: If a student misses a midterm examination, the exam will not be rescheduled. The student must follow the Instructions for Students Unable to Write Tests and provide documentation to their program within 24 hours of the missed test. The program will decide whether to allow the reweighting of the test, where reweighting means the marks normally allotted for the midterm will be added to the final exam. If no reasonable justification for missing the test can be found, then the student will receive a mark of zero for the test.

If a student is going to miss the midterm examination for religious reasons, they must inform the instructor in writing within 48 hours of the announcement of the exam date or they will be required to write the exam.

Cheating and Plagiarism: Students must write their essays and assignments in their own words. Whenever students take an idea or a passage from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. University policy states that cheating, including plagiarism, is a scholastic offence. The commission of a scholastic offence is attended by academic penalties, which might include expulsion from the program. If you are caught cheating, there will be no second warning.

All required papers may be subject to submission for textual similarity review to commercial plagiarism-detection software under license to the University for the detection of plagiarism. All papers submitted will be included as source documents on the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between the University of Western Ontario and Turnitin.com (<http://www.turnitin.com>).

Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, in the relevant section of the Academic Handbook:

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf

Use of Electronic Devices: Turn off all sound for pagers and cell phones. Students may use laptops, tablet computers, or smart phones *only* to access the course OWL site during lectures and tutorials. Use of *nonprogrammable* calculators *only* is permitted during quizzes and examinations. No other electronic devices may be used at any time during lectures, tutorials, or examinations.

Use of Personal Response Devices (“Clickers”): If clickers are used in a course, include a statement describing how they will be used that conforms to the requirements given on p. 2 and p. 4 of the course outlines policies in the Academic Handbook,

http://www.uwo.ca/univsec/pdf/academic_policies/exam/courseoutlines.pdf Omit

this section if your course does not use clickers.

Policy on Repeating All Components of a Course: Students who are required to repeat an Engineering course must repeat all components of the course. No special permissions will be granted enabling a student to retain laboratory, assignment, or test marks from previous years. Previously completed assignments and laboratories cannot be resubmitted by the student for grading in subsequent years.

Internet and Electronic Mail: Students are responsible for regularly checking their Western e-mail and the course web site (<https://owl.uwo.ca/portal/>) and making themselves aware of any information that is posted about the course. If the student fails to act on information that has been posted on these sites and does so without a legitimate explanation (i.e., those covered under the illness/compassionate form), then there are NO grounds for an appeal.

Accessibility: Please contact the course instructor if you require material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 519-661-2111 ext. 82147 for any specific question regarding an accommodation.

Support Services: Office of the Registrar, <http://www.registrar.uwo.ca/>
Student Development Centre, <http://www.sdc.uwo.ca/>
Engineering Undergraduate Services, <http://www.eng.uwo.ca/undergraduate/>
USC Student Support Services, <http://westernusc.ca/services/>

Students who are in emotional/mental distress should refer to Mental Health @ Western, http://www.health.uwo.ca/mental_health/, for a complete list of options about how to obtain help.

STATEMENT ON GENDER-BASED AND SEXUAL VIOLENCE

Western [is committed to reducing incidents of gender-based and sexual violence](#) and providing compassionate support to anyone who has gone through these traumatic events. If you have experienced gender-based or sexual violence (either recently or in the past), you will find information about support services for survivors, including emergency contacts, [here](#). To connect with a case manager or set up an appointment, please contact support@uwo.ca.

**INSTRUCTIONS FOR STUDENTS UNABLE TO WRITE TESTS OR EXAMINATIONS OR SUBMIT
ASSIGNMENTS AS SCHEDULED**

If, on medical or compassionate grounds, you are unable to write term tests or final examinations or complete course work by the due date, you should follow the instructions listed below. You should understand that academic relief will not be granted automatically on request. You must demonstrate to your department (or the Undergraduate Services Office) that there are compelling medical or compassionate grounds that can be documented before academic relief will be considered. Different regulations apply to term tests, final examinations and late assignments. Please read the instructions carefully.

A. GENERAL REGULATIONS & PROCEDURES

1. All first-year students will report to the Undergraduate Services Office by submitting the [Academic Consideration Request Form](#), for all instances.
2. If you are an upper year student and you are missing a test/assignment/lab or examination you will report the absence by submitting [Academic Consideration Request Form](#). Absences worth LESS THAN 10% of your mark, will be processed by your department office. If your course work is worth 10% OR MORE of your final grade, your request will be processed by the Undergraduate Services Office.
3. Check the course outline to see if the instructor has a policy for missed tests, examinations, late assignments or attendance.
4. Documentation must be provided as soon as possible. If no one is available in your department office or the Undergraduate Services Office, leave a message clearly stating your name & student number and reason for your call. The department telephone numbers are given at the end of these instructions.
5. If you decide to write a test or an examination you should be prepared to accept the mark you earn. Rewriting tests or examinations or having the value of a test or examination reweighted on a retroactive basis is not permitted.

B. TERM/MIDTERM TESTS

1. If you are in first year and you are unable to write a midterm/term test, contact the Undergraduate Services Office, SEB 2097 PRIOR to the scheduled date of the test.
2. If you are an upper year student and you are unable to write a midterm/term test, inform your instructor PRIOR to the scheduled date of the test and request relief through the [Academic Consideration Request Form](#). If the instructor is not available, leave a message for him/her at the department office. If the test is worth LESS THAN 10% of your mark, your request for relief will be processed by your department office. If the test is worth MORE THAN 10% of your final grade your request for relief will be processed by the Undergraduate Services Office.
3. Be prepared to attach supporting documentation to the Department Chair and/or the Undergraduate Services Office through the online form (see next page for information on documentation).

4. Discuss with the instructor if and when the test can be rescheduled. The approval of the Chair or the Undergraduate Services Office is required when rescheduling midterm/term tests.

C. FINAL EXAMINATIONS

1. If you are unable to write a final examination, contact the Undergraduate Services Office PRIOR TO THE SCHEDULED EXAMINATION TIME to report your absence using the [Academic Consideration Request Form](#) and request permission to write a Special Final Examination. If no one is available in the Undergraduate Services Office, leave a message clearly stating your name & student number.
2. Be prepared to provide the Undergraduate Services Office with supporting documentation (see next page for information on documentation) the next day, or as soon as possible (in cases where students are hospitalized). The following circumstances are not considered grounds for missing a final examination or requesting special examinations: common cold, headache, sleeping in, misreading timetable and travel arrangements.
3. In order to receive permission to write a Special Examination, you must obtain the approval of the Chair of the Department **and** the Associate Dean and in order to apply you must submit an "[Application for a Special Exam](#)" form. The Undergraduate Services Office will then notify the course instructor(s) and reschedule the examination on your behalf.

PLEASE NOTE: It is the student's responsibility to check the date, time and location of the Special Examination.

D. LATE ASSIGNMENTS

1. Advise the instructor if you are having problems completing the assignment on time (**prior** to the due date of the assignment).
2. Be prepared to submit the [Academic Consideration Request Form](#) and provide documentation if requested by the instructor (see reverse side for information on documentation).
3. If you are granted an extension, establish a due date. The approval of the Chair of your Department (or the Assistant Dean, First Year Studies, if you are in first year) is not required if assignments will be completed prior to the last day of classes.
4.
 - i) Extensions beyond the end of classes must have the consent of the instructor, the department Chair and the Associate Dean, Undergraduate Studies. Documentation is mandatory.
 - ii) A Recommendation of Incomplete Form must be filled out indicating the work to be completed and the date by which it is due. This form must be signed by the student, the instructor, the department Chair and the Associate Dean, Undergraduate Studies.

E. SHORT ABSENCES

If you miss a class due to a minor illness or other problem, check your course outlines for information regarding attendance requirements and make sure you are not missing a test, laboratory or assignment. Cover any readings and arrange to borrow notes from a classmate.

F. EXTENDED ABSENCES

If you are absent more than one week or if you get too far behind to catch up, you should consider reducing your workload by dropping one or more courses. (Note drop deadlines listed below). You are strongly encouraged to seek advice from your Academic Counsellor in the Undergraduate Services Office.

G. DOCUMENTATION

If you consulted an off-campus doctor or Student Health Services regarding your illness or personal problem, you must provide the doctor with a **Student Medical Certificate** to complete at the time of your visit and

then bring it to the Department (or the Undergraduate Services Office). **This note must contain the following information: severity of illness, effect on academic studies and duration of absence. Regular doctor's notes will not be accepted; only the Student Medical Certificate will be accepted.**

In Case of Serious Illness of a Family Member: Provide a Student Medical Certificate to your family member's physician to complete and bring it to the Department (or the Undergraduate Services Office if you are in first year).

In Case of a Death: Obtain a copy of the death certificate or the notice provided by the funeral director's office. You must include your relationship to the deceased and bring it to the Department (or the Undergraduate Services Office if you are in first year).

For Other Extenuating Circumstances: If you are not sure what documentation to provide, ask the Departmental Office (or the Undergraduate Services Office if you are in first year) for direction.

Note: Forged notes and certificates will be dealt with severely. To submit a forged document is a scholastic offence (see below).

H. **ACADEMIC CONCERNS**

1. You need to know if your instructors have a policy on late penalties, missed tests, etc. This information may be included on the course outlines. If not, ask your instructor(s).
2. **You should also be aware of attendance requirements in some courses. You can be debarred from writing the final examination if your attendance is not satisfactory.**
3. If you are in academic difficulty, check out the minimum requirements for progression in the calendar. If in doubt, see your Academic Counsellor.

Calendar References: Check these regulations in your 2023 Western Academic Calendar available at www.westerncalendar.uwo.ca.

Absences Due to Illness:

https://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_135

Academic Accommodations for Students with Disabilities:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_10

Academic Accommodations for Religious or Holy Days:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_16

Course Withdrawals:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=6&SelectedCalendar=Live&ArchiveID=#Page_75

Examinations:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?PolicyCategoryID=5&command=showCategory&SelectedCalendar=Live&ArchiveID=#Page_78

Scheduling of Term Assignments:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=5&SelectedCalendar=Live&ArchiveID=#SubHeading_78

Scholastic Offences:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_20

Student Medical Certificate:

<https://www.eng.uwo.ca/files/undergraduate/student-medical-certificate.pdf>

Engineering Academic Regulations:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=4&SelectedCalendar=Live&ArchiveID=#Page_86

Note: These instructions apply to all students registered in the Faculty of Engineering regardless of whether the courses are offered by the Faculty of Engineering or other faculties in the University.

Add Deadlines:

First term half course (i.e. “A” or “F”)	September 15, 2023
Full courses and full-year half course (i.e. “E”, “Y” or no suffix)	September 15, 2023
Second term half course (i.e. “B” or “G”)	January 16, 2024

Drop Deadlines:

First term half course without penalty (i.e. “A” or “F”)	November 13, 2023
Full courses and full-year half courses without penalty (i.e. “E”, “Y” or no suffix)	November 30, 2023
Second term half or second term full course without penalty (i.e. “B” or “G”)	March 7, 2024

Contact Information:

Undergraduate Services Office: engugrad@uwo.ca	SEB 2097 Phone: 519-661-2130	E-mail:
Chemical & Green Process Engineering: cbeugrad@uwo.ca	TEB 477 Phone: 519-661-2131	E-mail:
Civil Engineering: civil@uwo.ca	SEB 3005 Phone: 519-661-2139	E-mail:
Computer, Electrical, Mechatronic Systems & Software Engineering ceugrad@uwo.ca	TEB 279 Phone: 519-661-3758	E-mail:
Integrated Engineering engceli@uwo.ca	ACEB 2410 Phone: 519-661-6725	E-mail:
Mechanical Engineering: mmeundergraduate@uwo.ca	SEB 3002 Phone: 519-661-4122	E-mail:

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