

ELEC 482 – Electrical Drive Systems

Term – Spring 2018 (201801)

Instructor

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Office Hours

Day: Wednesdays
Time: 2:30 to 4:30 PM
Location: EOW 407

Course Objectives

Electrical drive systems are gaining popularity with every passing day. Home appliance market and the traditional industrial drives market have already accepted electrical drive systems and are reaping rich dividends. Focus on electric transportation has furthered electrical drive system's penetration in society. Consequently, it is important for a modern engineer to be familiar with the fundamentals of electrical drive systems. ELEC 482 provides an ideal opportunity for you, as an upcoming engineer, to get introduced to the world of electrical drive systems. The primary objectives of the course are to:

- (a) Inform the advantages of electrical drive systems
- (b) List the components that constitute electrical drive systems
- (c) Analyze a few popular electrical drive systems

Learning Outcomes

By enrolling in ELEC 482 and actively involving yourself in the learning process, you shall be able to

- (i) Define an electrical drive system
- (ii) Justify the need for electrical drive system for a given application
- (iii) List the elements that make an electrical drive system
- (iv) Analyze a given application from an electrical drive system perspective
- (v) Develop mathematical models of key components of an electrical drive system
- (vi) Compute the operating parameters and assess the performance of a drive system
- (vii) Identify the benefits and limitations of different control strategies used in electrical drives
- (viii) Examine the most common means of implementing electrical drive controls
- (ix) Simulate a few electrical drive systems using MATLAB/Simulink

Syllabus

The syllabus for the course comprises of:

Elements of drive systems, characterization of mechanical loads, requirements of electrical drive systems, dynamic equations and modelling of electrical machines, dc drives with various dc power sources, induction motor drives, ac controller, slip-energy recovery, constant air-gap flux, synchronous motor drives, permanent magnet motors, reluctance motors.

In order to benefit fully from the course, it is essential you have an in-depth knowledge about Electrical Machines (**pre-requisite course: ELEC 370**). Further, if you are familiar with control systems terminologies and power electronic devices & circuits, it would be a great asset.

Lecture

A-Section(s): A01 / CRN **21127**
Days: Tuesdays, Wednesdays, Fridays
Time: 12:30 PM to 1:20 PM
Location: Elliott Building 060

Marker TA – Mehran Amigh
Email id: mehranamigh@uvic.ca

Required Text

Entire course will be based on the following text book. Assignments will also be from this text book. Therefore, it is essential you have it with you.

Title: Fundamentals of Electrical Drives

Author: G. K. Dubey

Publisher: Alpha Science International Ltd.

Edition: 2nd Edition

References:

As a new learner of this advanced topic, you might benefit immensely by referring to these books in addition to the text book.

- 1) *Power Electronics and AC Drives* by **Bimal K. Bose**
- 2) *Power Electronics: Circuits, Devices and Applications* by **Muhammad H. Rashid**
- 3) *Electric Machines and Drives – A first course* by **Ned Mohan**
- 4) *Dynamic Simulations of electric machinery: Using MATLAB/Simulink* by **C. M. Ong**

Required Software:

In addition to utilizing the text book, we will rely on simulations using MATLAB/Simulink quite extensively to simulate the drive systems covered in the course. MATLAB simulation is a skill that is widely sought after by modern industries. Hence, you would gain by acquiring this skill.

- MATLAB/Simulink, Student version (<https://matlab.engr.uvic.ca/>)

Assessment:

Validating one's learning is important and hence in ELEC 482, many opportunities will be provided to you to assess your learning. In order to ensure you have enough time to take appropriate corrective actions upon assessing, I propose the following periodic assessment scheme:

| | | |
|-------------------------|-------------|---|
| Weekly in-class quizzes | 5 x 2 = 10% | Wednesdays except 3-Jan-18, 14-Feb-18 & 21-Feb-18 |
| Assignments: | 2 x 5 = 10% | Due Dates: 29-Jan-2018 & 19-Mar-2018 |
| Mid-term | 1x20 = 20% | Due Date: 9-Feb-2018 |
| MATLAB Project | 1x10 = 10% | Due Date: 9-Mar-2018 |
| Final Exam | 1x50 = 50% | Date: To be announced |

I have furnished more details about each of the assessment scheme in Appendix A. Please take time to read through it.

Further, as most of you would be graduating soon after completing ELEC 482, I believe it is important that these assessments also help you nurture professionalism. Therefore, about 10% of marks would be allotted towards:

- (a) On-time submission
- (b) Organization & legible presentation
- (c) Submitting reports/assignments in appropriate location

The final grade obtained from the above marking scheme for the purpose of GPA calculation will be based on the percentage-to-grade point conversion table as listed in the current Undergraduate Calendar.

<https://web.uvic.ca/calendar2018-01/undergrad/info/regulations/grading.html>

There will be no supplemental examination for this course.

Note to students: Students who have issues with the conduct of the course should discuss them with the instructor first. If these discussions do not resolve the issue, then students should feel free to contact the Chair of the Department by email or the Chair's Assistant to set up an appointment.

Accommodation of Religious Observance:

<https://web.uvic.ca/calendar2018-01/undergrad/info/regulations/religious-observanc.html>

Policy on Inclusivity and Diversity:

<https://web.uvic.ca/calendar2018-01/general/policies.html>

Standards of Professional Behavior: You are advised to read the Faculty of Engineering Document Standards for Professional Behavior, which contains important information regarding conduct in courses, labs, and in the general use of facilities. <https://www.uvic.ca/engineering/assets/docs/professional-behaviour.pdf>

Cheating, plagiarism and other forms of academic fraud are taken very seriously by both the University and the Department. You should consult the entry in the current Undergraduate Calendar for the UVic policy on academic integrity.

<https://web.uvic.ca/calendar2018-01/undergrad/info/regulations/academic-integrity.html>

Equality: This course aims to provide equal opportunities and access for all students to enjoy the benefits and privileges of the class and its curriculum and to meet the syllabus requirements. Reasonable and appropriate accommodation will be made available to students with documented disabilities (physical, mental, learning) in order to give them the opportunity to successfully meet the essential requirements of the course. The accommodation will not alter academic standards or learning outcomes, although the student may be allowed to demonstrate knowledge and skills in a different way. It is not necessary for you to reveal your disability and/or confidential medical information to the course instructor. If you believe that you may require accommodation, the course instructor can provide you with information about confidential resources on campus that can assist you in arranging for appropriate accommodation. Alternatively, you may want to contact the Center for Accessible Learning located on campus. The University of Victoria is committed to promoting, providing, and protecting a positive, and supportive and safe learning and working environment for all its members.

Course Lecture Notes: As a first time learner of electrical drive systems, you are encouraged to study the text book and the reference books listed. Therefore, I shall refrain from providing any lecture notes. On the other hand, I shall supply you with a tentative schedule of topics I intend to discuss during lecture hours. I recommend strongly that you spend time reading about the topic both before and after the lecture. Where ever appropriate, I might supply a few materials that would supplement the text book. Unless otherwise noted, all course materials supplied to students in this course are intended for use in this course only. These materials are NOT to be re-circulated digitally, whether by email or by uploading or copying to websites, or to others not enrolled in this course. Violation of this policy may in some cases constitute a breach of academic integrity as defined in the UVic Calendar.

Course Evaluation: Towards the end of term, as in all other courses at UVic, you will have the opportunity to complete an anonymous survey regarding your learning experience (CES). The survey is vital to providing feedback to me regarding the course and my teaching, as well as to help the department improve the overall program for students in the future. When it is time for you to complete the survey you will receive an email inviting you to do so. You will need to use your UVic Netlink ID to access the survey, which can be done on your laptop, tablet, or mobile device. I will remind you and provide you with

more detailed information nearer the time but please be thinking about this important activity during the course.

Continuous Feedback: I am committed to a memorable learning experience for my students, and I will try my best to help out in whatever way I can. For that I need to receive your input throughout the course. Oral/written/email feedback are all welcome anytime during the term.

Appendix A

Assessment:

As indicated in the course outline, I suggest the following periodic assessment scheme:

| | | |
|-------------------------|-------------|---|
| Weekly in-class quizzes | 5 x 2 = 10% | Wednesdays except 3-Jan-18, 14-Feb-18 & 21-Feb-18 |
| Assignments: | 2 x 5 = 10% | Due Dates: 29-Jan-2018 & 19-Mar-2018 |
| Mid-term | 1x20 = 20% | Due Date: 9-Feb-2018 |
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| Final Exam | 1x50 = 50% | Date: To be announced |

In-class quizzes:

The main objective of the quizzes is to provide instant and frequent feedback about your understanding of the course material. Key information about these quizzes are:

Day: Every Wednesday (except on 3rd January, 14th February and 21st February 2018)

Time: During lecture hour

Duration: 10 minutes

Type of questions: Multiple choice questions or descriptive type

Restrictions: No discussion with peers

Accommodations: You can refer to any resource such as notes, text book or internet

Calculator: Any type of calculator can be used

Weightage: Each quiz will have 2% weightage

I do understand that you might not be able to appear for all the quizzes. Hence, I shall consider only your best 5 performances towards the course.

Assignments:

In my opinion, assignments are equivalent to take home exams. Hence, I prefer you work independently while answering assignment questions. There will be 2 assignments. Each assignment might have about 10 questions.

As there are about 60 registered students and only one marker, to provide quick and meaningful feedback, not all assignment questions will be marked. I shall randomly pick a few questions to be marked. However, I shall post detailed solution for each and every assignment question within 4 days from the assignment submission deadline. Along with the solution, I shall also post a marking scheme that would be followed by the TA. In case you find any issue with the way your assignment is marked, please do not hesitate to contact the TA via email.

Some important information about assignments are given below:

Submission due dates: 29-Jan-2018 (assignment 1) & 19-Mar-2018 (assignment 2)

Submission timeline: 5 PM on the due date

Weightage: Each assignment is worth 5%

Please note, as a way to nurture professionalism, I would assign some marks for the following:

- (a) On-time submission
- (b) Legible presentation including writing your name/student number
- (c) Methodical approach to problem solving
- (d) Dropping-off the assignment in appropriate location

Further, to ensure fairness, I might have to penalize late submissions.

Midterm:

Midterm exam will help you review all topics covered in the first month of the term. Some useful information about the midterm exam are given below:

Date: 9-Feb-2018

Time: During lecture hour

Duration: 45 minutes

Type of questions: Multiple choice questions and descriptive type

Restrictions: No discussion with peers, no access to text book or lecture notes or internet

Accommodations: Hand-written notes up to two single sided A4 sheets

Calculator: Any type of calculator can be used

Weightage: Midterm exam will be worth 20%

Please note, at the end of the midterm exam you are expected to submit your notes along with the answer booklet. Again, I shall assign a few marks for legible and methodical presentation just to ensure you present your answers in a professional manner.

MATLAB Project:

One of the key learning outcomes from this course is the ability to simulate electric drive systems using MATLAB/Simulink. To accomplish this learning outcome, I shall assign a take home project. I shall upload more details about this project on Coursespace before the reading break week.

Please note, all students will be working on the same simulation model to ensure fairness. To assess your performance in this project, I shall meet with each of you individually. During this meeting you are expected to run the simulation in your laptop or in a lab computer. I shall be asking a few questions to test your understanding of the model and your competence in MATLAB/Simulink. I shall make sure to ask questions of similar difficulty level to all of you. You need not submit any report for this project work.

You can setup the demonstration meeting on any mutually convenient day between 26th February and 9th March. I shall be providing more details on how to request for a meeting during one of the lectures.

Final Exam:

Final exam will be comprehensive in nature i.e. any topic discussed during the term can be tested. Some key information about the final exam are given below:

Date: To be announced

Time: To be announced

Duration: 3 hours

Type of questions: Multiple choice questions and descriptive type

Restrictions: No discussion with peers, no access to text book or lecture notes or internet

Accommodations: Hand-written notes up to two single sided A4 sheets

Calculator: Any type of calculator can be used

Weightage: Final exam will be worth 50%

Please note, at the end of the final exam you are expected to submit your notes along with the answer booklet. Finally, I shall assign a few marks for legible and methodical presentation just to ensure you present your answers in a professional manner.