



University of Ontario Institute of Technology

Faculty of Engineering and Applied Science

Department of Automotive, Mechanical and Manufacturing Engineering

Course Outline

METE 3100U

Actuators and Power Electronics

Winter 2019

Offering Approval:

Approved

Course Description:

This course covers the fundamentals of AC and DC actuators, the necessary power electronics to interface with them, along with their basic control. Topics include: AC synchronous and induction motors; DC servo and stepper motors, power electronics, including H-bridges, PWM control, interfacing, power amplifiers, and transformers; and an introduction to speed and torque control of motors.

Major Topics:

Graduate Attributes:

The graduate attributes developed and required by the Canadian Engineering Accreditation Board's Accreditation Criteria and Procedures are listed below, with those covered in the course to some degree (introduced, developed, applied). More details about the accreditation of engineering programs and graduate attributes can be found here: <http://www.engineering.uoit.ca/undergraduate/ceab-accredited-programs-and-admissions>

Attributes	Covered in this Course
Knowledge base	✓
Problem analysis	✓
Investigation	✓
Design	✓
Use of engineering tools	✓
Individual and team work	✓
Communication skills	✓
Professionalism	✗
Impact of engineering on society and the environment	✗
Ethics and equity	✗
Economics and project management	✓
Life-long learning	✗

Course Content Breakdown

Math	Basic Science	Complementary Studies	Engineering Science	Engineering Design
0%	0%	0%	75%	25%

Instructors

Instructor: **Email:** **Office:** **Phone:** **Office Hours:**
[Dr. Carlos Rossa](#) carlos.rossa@uoit.ca SIRC 3383 905.721.8668 x 7340 Wed 12:00-14:00, Frid 12:00-1400

Teaching Assistants

TA Name: **Email:** **Office:** **Office Hours:**
 Brayden Kent brayden.kent@uoit.net SIRC 3310 Wed 15:30-16:30

Reference Books and Information Sources:

- Electric machines and power electronics, P.C. Sen, any edition
- Power electronics, devices, circuits, and applicaitons - M. Rashid, any edition

Course Organization and Delivery Mode:

The course is composed of:

- Three hours of in-class lectures per week
- Two hours of laboratory sessions every two weeks

Scheduled Regular Class Meeting Times:

Class schedule:

- Wednesdays 14:10-15:30 - UA2120

- Fridays 14:10-15:30 - UA2120

Please note: Lecture notes are not self-contained. Students are strongly encouraged to **attend every lecture** and lab session.

Lab sessions (CRN 74499)

- Tuesday 9:10 am - 11:00 am 11:00 am SIRC 2030 Jan 08

- Tuesday 9:10 am - 11:00 am 11:00 am SIRC 2030 Jan 22

- Tuesday 9:10 am - 11:00 am 11:00 am SIRC 2030 Feb 05

- Tuesday 9:10 am - 11:00 am 11:00 am SIRC 2030 Feb 26

- Tuesday 9:10 am - 11:00 am 11:00 am SIRC 2030 Mar 01

Lab sessions (CRN 74500)

- Tuesday 9:10 am - 11:00 am SIRC 2030 Jan 15

- Tuesday 9:10 am - 11:00 am SIRC 2030 Jan 29

- Tuesday 9:10 am - 11:00 am SIRC 2030 Feb 12

- Tuesday 9:10 am - 11:00 am SIRC 2030 Mar 05

- Tuesday 9:10 am - 11:00 am SIRC 2030 Mar 19

- Tuesday 9:10 am - 11:00 am SIRC 2030 Apr 02

Final Grade Breakdown:

The grading policy is as follows:

- Midterm 1 - 15%

- Midterm 2 - 15%

- Laboratory reports - 15%
- Design project: 10%
- Final examination: 40%
- Laboratory examination: 5% (done during the final exam)

Total: 100%

Participation marks: Additional bonus marks, up to a maximum of 5%, will be offered at the discretion of the course instructor during the lectures to students who actively participate in class activities.

Laboratory reports (15%): All 5 reports will be marked. Lab attendance is mandatory.

Laboratory exam (5%): A separate written exam will be given to students during the final exam. It will include any topic covered during the laboratory sessions.

Design project (10%): A design project will be given to students at the beginning of the term and will be handed in during the last lecture.

Assignments (0%): Assignments will not be marked.

Midterms (30%): Each midterm exam will account for 15% of the final grade. There will be 2 midterms. The second midterm is cumulative.

Final exam (40%): The final exam is a comprehensive written exam. It will reflect the material covered throughout the whole course; this includes lectures and labs.

Midterms

Midterm Date:	Midterm Location:
Friday, February 8, 2019 - 14:10 to 15:30	UA 2120
Midterm Date:	Midterm Location:
Friday, March 15, 2019 - 14:10 to 15:30	UA 2120

Assignments:

There will be up to 6 assignments. Assignments will be given throughout the semester and solutions will be posted on Blackboard. The assignments will not be marked and are not included in the grading distribution. They will rather be used to help students prepare for the midterms and the final examination.

MATLAB/Simulink, LTspice, or other circuit software will be used in solving problems and assignments as required.

Prelab Reports, Notes and Reports:

Laboratory reports (15%)

Five experiments will be run throughout the semester, for five different experiments. Lab attendance is mandatory. The lab manual and schedule will be posted on Blackboard. Lab reports will be handed to the Lab instructor prior to the beginning of the next Lab. No late submission will be accepted. Students must attend their registered lab sessions.

Lab 1 - Introduction, microcontroller interfacing, and DC/DC converter for voltage and current control

Lab 2 - PWM speed and current control of a DC motor with an H-bridge

Lab 3 - Servo and brushless motor control

Lab 4 - Stepper motor, and speed control

Lab 5 - AC and induction motors

Laboratory examination (included in the final exam (5%))

During the final examination, the students will be given an additional separate written exam (20-30 min long) that covers all laboratory experiments and topics. This laboratory exam will account for 5% of the final grade.

Design project (10%)

Students will be given a design project at the beginning of the semester that involves design, modelling, simulation, and analysis of an electromechanical system that includes different aspects of actuators and power electronics. Students will have a choice between different projects and one project may be conducted by a group of up to 3 students. The project will be handed in in the form of a report written in Latex using a provided template. Reports must be handed in during the last lecture. Late reports will not be accepted. Design reports will be evaluated as follows:

- Overall technical rigour and accuracy: 2.5%

- Electromechanical modelling: 2.5%

- Electromechanical simulation: 2.5%

- Language and clarity: 1.25%

- Presentation and graphics: 1.25%

Design report is due on April 5 at 15:30

Students are strongly encouraged to meet with the course instructor throughout the term to review the design project progress on a regular basis.

Computer Experience:

Students are expected to have their UOIT-provided laptop during all lectures and lab sessions. The following software will be required throughout the course:

- Matlab and Simulink

- LTspice, Orcad, or NI Multisim

- Latex software package

Summary of Important Dates and Marking Scheme:

- Midterm 1 - 15% (February 8, during lecture hours)

- Midterm 2 - 15% (March 15, during lecture hours)

- Labs reports - 15%

- Design project: 10% (due April 05 at 15:30)

- Final examination (40%) and lab examination (5%): During final exam period (April 8-20)

- Total: 100%

- Participation marks: additional 5% bonus (done during lectures only - attendance is mandatory)

Other Course Information:

Class attendance: Students are strongly encouraged to attend every lecture and lab session. Bonus marks, to a maximum of 5%, will be offered at the discretion of the course instructor to the students who actively participate in class activities. The lecture notes posted on the BlackBoard are designed for in-class use and are not self-contained. If a student is not able to attend a lecture or tutorial on a particular day, it is their responsibility to find out what materials were covered and which problems were either solved or assigned. Students are encouraged to study the materials given in lectures continuously and visit the course content on BlackBoard regularly for deadlines, announcements, and the solutions to assignments, quizzes, and tests.

Lab reports: All the lab reports must be handed on time on the due date. Late reports will not be accepted.

Design project report: The design project report must be handed in during the last lecture. Late reports will not be accepted.

ID: Each student must present a photo ID during an examination.

Academic misconduct: Cheating, plagiarism or any other form of academic misconduct as outlined in Section 5.15 of the UOIT Academic Calendar will be punished to the fullest extent. Posting any course material to or the using Chegg is a breach of the academic calendar and will lead to misconduct charges.

Email: Please do not contact the course instruction via Blackboard. Email the instructor directly for a faster response.

Missed exams: A missed midterm examination for legitimate reasons will be reweighted onto the final exam accordingly, provided that a formal request is submitted to the Faculty and approved by the Academic Advisor. Late assignments or lab reports will not be considered.

Note: The above topics and outline are subjected to adjustments and changes as needed.

Content share: Students are **NOT** allowed to share the contents posted on BlackBoard on CourseHero, Chegg or any other external website. All contents made available to students are copyright-protected. Any unauthorized copying, distribution, online posting, or using of the contents is subject to an infringement of the Copyright Act of Canada and constitutes a breach of UOIT academic calendar.

Medical Certificates and Deferred Exams:

Medical statements and academic consideration forms for any missed student work worth 25% or less (not including midterms or tests) will be submitted directly to the course instructor. This includes missed quizzes, assignments and labs.

Missed Midterms or Coursework Worth More than 25%

For any missed midterms or tests, regardless of weight, or coursework worth more than 25%, students will need to submit the UOIT Medical statement or academic consideration form to the FEAS Advising Office following the form guidelines.

Guidelines for Medical Statements

Medical statements cover any missed work due to a medical reasons. The student must:

- See a medical doctor within 24 hours of the missed work
- Submit the form to the correct individual within 3 working days

Guidelines for Academic Consideration Forms

Academic consideration forms cover any missed work for non-academic grounds, for example, religious observations, court appearance, personal/family emergency, varsity events. The student must provide supporting documentation if deemed necessary.

Should the medical certificate proven to be invalid due to any kind of action by the student, such student's behaviour will be considered as a major misconduct and respective disciplinary actions will be commenced.

Failure to comply with the above will result in an mark of 0 for the exam.

Accessibility:

Students with disabilities may request to be considered for formal academic accommodation in accordance with the Ontario Human Rights Code. Students seeking accommodation must make their requests through the Centre for Students with Disabilities in a timely manner, and provide relevant and recent documentation to verify the effect of their disability and to allow the University to determine appropriate accommodations.

Accommodation decisions will be made in accordance with the Ontario Human Rights Code. Accommodations will be consistent with and supportive of the essential requirements of courses and programs, and provided in a way that respects the dignity of students with disabilities and encourages integration and equality of opportunity. Reasonable academic accommodation may require instructors to exercise creativity and flexibility in responding to the needs of students with disabilities while maintaining academic integrity.

Academic Integrity and Conduct:

Students and faculty at UOIT share an important responsibility to maintain the integrity of the teaching and learning relationship. This relationship is characterized by honesty, fairness and mutual respect for the aim and principles of the pursuit of education. Academic misconduct impedes the activities of the university community and is punishable by appropriate disciplinary action.

Students are expected to be familiar with UOIT's regulations on Academic Conduct (Section 5.15 of the Academic Calendar) which sets out the kinds of actions that constitute academic misconduct, including plagiarism, copying or allowing one's own work to be copied, use of unauthorized aids in examinations and tests, submitting work prepared in collaboration with another student when such collaboration has not been authorized, and other academic offences. The regulations also describe the procedures for dealing with allegations, and the sanctions for any finding of academic misconduct, which can range from a written reprimand to permanent expulsion from the university. A lack of familiarity with UOIT's regulations on academic conduct does not constitute a defense against its application.

Further information about academic misconduct can be found in the Academic Integrity link on your laptop.

Turnitin:

UOIT and faculty members reserve the right to use electronic means to detect and help prevent plagiarism. Students agree that by taking this course all assignments are subject to submission for textual similarity review by Turnitin.com. Assignments submitted to Turnitin.com will be included as source documents in Turnitin.com's restricted access database solely for the purpose of detecting plagiarism in such documents for five academic years. The instructor may require students to submit their assignments electronically to Turnitin.com or the instructor may submit questionable text on

behalf of a student. The terms that apply to UOIT's use of the Turnitin.com service are described on the Turnitin.com website.

Students who do not wish to have their work submitted to Turnitin.com must provide with their assignment at the time of submission to the instructor a signed Turnitin.com Assignment Cover sheet:

<http://www.uoit.ca/assets/Academic~Integrity~Site/Forms/Assignment%20Cover%20sheet.pdf>

Further information about Turnitin can be found on the Academic Integrity link on your laptop.

Student Sexual Violence Policy

UOIT is committed to the prevention of sexual violence in all its forms. For any UOIT student who has experienced Sexual Violence, UOIT can help. UOIT will make accommodations to cater to the diverse backgrounds, cultures, and identities of students when dealing with individual cases. If you think you have been subjected to or witnessed sexual violence:

- Reach out to a Support Worker, who are specially trained individuals authorized to receive confidential disclosures about incidents of sexual violence. Support Workers can offer help and resolutions options which can include safety plans, accommodations, mental health support, and more. To make an appointment with a Support Worker, call 905.721.3392 or email supportworker@uoit.ca
- Learn more about your options at: www.uoit.ca/sexualviolence

Freedom of Information and Protection of Information Act:

The following is an important notice regarding the process for submitting course assignments, quizzes and other evaluative material in your courses.

As you may know, UOIT is governed by the Freedom of Information and Protection of Information Act ("FIPPA"). In addition to providing a mechanism for requesting records held by the university, this legislation also requires that UOIT not disclose the personal information of its students without their consent.

FIPPA's definition of "personal information" includes, among other things, documents that contain both your name and your Banner ID. For example, this could include graded test papers or assignments. To ensure that your rights to privacy are protected, UOIT encourages you to use only your Banner ID on assignments or test papers being submitted for grading. This policy is intended to prevent the inadvertent disclosure of your information where graded papers are returned to groups of students at the same time. If you still wish to write both your name and your Banner ID on your tests and assignments, please be advised that UOIT will interpret this as an implied consent to the disclosure of your personal information in the normal course of returning graded materials to students.

If you have any questions or concerns relating to the new policy or the issue of implied consent addressed above, please contact the UOIT privacy office.

Detailed Course Content:

This course covers the fundamentals of actuators and power electronics and is divided into two parts.

Part 1 - Power electronics. This part of the course covers the necessary electronic systems required to power and control electric motors. This includes the fundamentals of magnetic circuits, transformers, diode power rectifiers, DC/DC and DC/AC converters, pulse-width modulation, choppers, H-bridges, interfaces, and power amplifiers.

Part 2 - Actuators modelling, interfacing, and control. This part of the course covers the principles of AC and DC actuators, along with their basic control. Topics include AC synchronous and induction motors; DC servo and stepper motors, and torque and speed control of motors.