Ryerson University

Department of Electrical & Computer Engineering
Faculty of Engineering & Architectural Science

Course Outline W2017

ELE654 Power Electronics

Instructor	Dr. Dewei(David) Xu Office: ENG333 Phone: 416-979-5000 ext 6075 E-mail: dxu@ryerson.ca Office Hours: Tuesday 4-6PM
Calendar Description	A course on microprocessor-controlled solid state converters. Major topics include: switching devices (SCR, MOSFET, IGBT, GTO, etc.), dc-dc switch mode converters, diode and thyristor rectifiers, current and voltage source inverters, industry applications and microprocessor programming techniques. Typical control schemes for these converters will also be discussed. Important concepts are illustrated with laboratory design projects. Microprocessor based digital controlled power electronic platform will be used in the projects.
Prerequisites	ELE504
Compulsory Text(s):	"Power Electronics -- Converters, Applications and Design" by N.Mohan, T.Undeland and W.Robbins, published by John Wiley & Sons, Inc.
Reference Text(s)	"Fundamental of Power Electronics, Second Edition" by R.W. Erickson and D. Maksimovic, published by Springer Science+Business Media Inc.
Learning Objectives (Indicators)	At the end of this course, the successful student will be able to: 1) Interconnect the concepts of various engineering knowledge to design and solve the real world engineering problem (1c) 2) Predict the outcomes of power converter experiment and justify the assumptions given. (3d) 3) Generate solutions for more complex power converter design (4d). 4) Design and develop software to perform the given tasks in the project. (5c). 5) Demonstrate and explain the result using graphics, waveforms and others. (7d) **NOTE**: *Numbers in parentheses refer to the graduate attributes required by the Canadian Engineering Accreditation Board (CEAB).*
Course Organization	3 hours lecture every week 2 hours laboratory every week
Teaching Assistants	Yu Ho: yuavision@gmai.com Shuai Wang: wangshuai@ryerson.ca
Course Evaluation	• Theoretical component 65% Mid-term Examination 25% Final Examination 40% • Laboratory component 35% Digital controlled power electronic platform 5% Digital controlled dc-dc converter and dc motor drive 15% Digital controlled IGBT inverter and induction motor drive 15% Two formal reports on the projects are required. Each report will be assessed not only on academic and laboratorial performance, but also on the communication skills exhibited. In order to achieve a passing grade, the student must achieve an average of at least 50% in both

	theoretical and laboratory components.
Examinations	Midterm exam in approximately Week 7, two hours, closed-book. Final exam, during exam period, three hours, closed-book. Details will be announced in D2L

Course Content

1	dc-dc Switch Mode Converters	(pp 161-199)	9 hrs
	1.1 Introduction		
	1.2 Non-isolated DC/DC Converters		
	1.3 Isolated DC/DC Converters		
	1.4 Choppers		
	1.5 Control of dc-dc converters		
2	Diode and Thyristor Rectifiers	(pp 79-160)	9 hrs
	2.1 Introduction		
	2.2 Single and three phase diode rectifiers		
	2.3 Total harmonic distortions and power factor		
	2.4 Single and three phase thyristor (SCR) rectifiers		
	2.5 Control of thyristor rectifiers		
3	Inverters (dc -ac converters)	(pp 200-248)	9 hrs
	3.1 Introduction		
	3.2 Single-phase Inverters		
	3.3 Three-phase IGBT Inverters		
	3.4 PWM techniques		
	3.5 Current source Inverters		
	3.6 Induction Motor Speed Control	(pp 399-434)	
4	Applications	(pp 354-364, 367-398, 460-504)	6 hrs
	4.1 Introduction		
	4.2 Uninterruptible power supplies (UPS)		
	4.3 Power supplies		
	4.4 AC/DC Motor drives		
	4.5 Active power filters		
	4.6 Static var compensators		
	4.7 Electronic ballasts		
5	Design Considerations	(pp 667-743)	3 hrs
	5.1 Introduction		
	5.2 Snubber circuit design		
	5.3 Gate drive circuits		
	5.4 Heatsink design		

Laboratory/Tutorials

Project	Topic	Week #
Tutorial	Digital controlled power electronic platform	2-3
Project 1	Digital controlled dc-dc converter and dc motor drive	4-7
Project 2	Digital controlled IGBT inverter and induction motor drive	8-12

Note:

1) Each lab may contain micro-controller control code and experiment. The sample simulation models and frame of control code (in C language) will be provided in D2L.
2) A formal report is required for each lab. The reports should be handed in the first lab class of the next lab.

3) The laboratory component is not only evaluated based on the reports but also the lab performance during the lab class.

Important Notes

1. All of the required course-specific written reports will be assessed not only on their technical/academic merit, but also on the communication skills exhibited through these reports.

2. All assignment and lab/tutorial reports must have the standard cover page which must be signed by the student(s) prior to submission of the work. Submissions without the cover page **will not** be accepted. The cover page can be found on the departmental web site: Standard Assignment/Lab Cover Page

3. Should a student miss a mid-term test or equivalent (e.g. studio or presentation), with appropriate documentation, a make-up assessment ***may*** be scheduled. Alternatively, the weight of the missed work is placed on the final exam, or another single assessment. This may not cause that exam or assessment to be worth more than 70% of the student's final grade. If a student misses a scheduled make-up test or exam, the grade may be distributed over other course assessments even if that makes the grade on the final exam worth more than 70% of the final grade in the course. Make-up assessments cover the same material as the original assessment but need not be of an identical format.

4. Students who miss a final exam for a verifiable reason and who cannot be given a make-up exam prior to the submission of final course grades, must be given a grade of INC (as outlined in the *Grading Promotion and Academic Standing Policy)* and a make-up exam (normally within 2 weeks of the beginning of the next semester) that carries the same weight and measures the same knowledge, must be scheduled.

5. Medical or Compassionate documents for the missing of an exam must be submitted within 3 working days of the exam. Students are responsible for notifying the instructor that they will be missing an exam as soon as possible.

6. **If a student is requesting accommodation due to a religious, aboriginal and/or spiritual observance, he or she must submit a Request for Accommodation of Student Religious, Aboriginal, and Spiritual Observance AND an Academic Consideration form within the FIRST TWO WEEKS OF CLASS or, for a final examination, within two weeks of the posting of the examination schedule**. If the required absence occurs within the first two weeks of classes, or the dates are not known well in advance as they are linked to other conditions, these forms should be submitted with as much lead time as possible in advance of the required absence.
   Both documents are available at http://www.ryerson.ca/senate/forms/relobservforminstr.pdf. Full-time or part-time degree students must submit the forms to their own program department or school.

7. The results of the first test or mid-term exam will be returned to students before the deadline to drop an undergraduate course in good Academic Standing.

8. Students are required to adhere to all relevant University policies including:
   - Undergraduate Grading, Promotion and Academic Standing: http://www.ryerson.ca/senate/policies/pol46.pdf
   - Student Code of Academic Conduct: http://www.ryerson.ca/senate/policies/pol60.pdf
   - Student Code of Non-Academic Conduct: http://www.ryerson.ca/senate/policies/pol61.pdf
   - Undergraduate Academic Consideration and Appeals: http://www.ryerson.ca/senate/policies/pol134.pdf
   - Examination Policy: http://www.ryerson.ca/senate/policies/pol135.pdf
   - Course Management Policy: http://www.ryerson.ca/senate/policies/pol145.pdf
   - Accommodation of Student Religious, Aboriginal and Spiritual Observance: http://www.ryerson.ca/senate/policies/pol150.pdf
   - Establishment of Student E-mail Accounts for Official University Communication: http://www.ryerson.ca/senate/policies/pol157.pdf

9. Students are required to obtain and maintain a Ryerson e-mail account for timely communications between the instructor and the students.

10. Any changes in the course outline, test dates, marking or evaluation will be discussed in class prior to being implemented.

11. Assignments, projects, reports and other deadline-bound course assessment components handed in past the due date will receive a mark of ZERO. Marking information will be made available at the time when such course assessment components are announced.

12. If you have taken the course previously and are currently looking to get a laboratory exemption, then you must fill out this form: http://www.ee.ryerson.ca/guides/ECE-LabExemptionForm.pdf

Approved by: _____ Date _____
Course Instructor

Approved by: _____ Date _____
Associate Chair or Program Director