INSTITUT EN GÉNIE DE L'ÉNERGIE ÉLECTRIQUE
INSTITUTE OF ELECTRICAL POWER ENGINEERING

IGEE 401 – Power Electronic Systems (Poly ELE4451)
(Dispositifs d'électronique de puissance)

Course Outline
Fall 2016

Course Instructors:

Prof Géza Joós, Université McGill, coordinator
Dr. Khalil El Arroudi, Université McGill, course instructor
Office : Polytechnique Montréal, Pavillon principal, Room A-330.7
Telephone: 340-4711 ext. 3604
E-mails: khalil.elarroudi@mail.mcgill.ca
Office Hours: Monday, 13:00 – 15:00, Polytechnique Montréal, Room A-330.7

Equivalences:

ELEC 433	Power Electronics (Concordia University)
ELE 355	Électronique de puissance (ÉTS)
ELE 4451	Dispositifs d'électronique de puissance (Polytechnique Montréal)
ECSE 465	Power Electronic Systems (McGill University)
GEI 150	Électronique de puissance (Université de Sherbrooke)
GEL 4102	Électronique de puissance (Université Laval)
GEI 1063	Électronique de puissance (UQTR)
6GEI-402	Électronique de puissance (UQAC)
GEN 43109	Électronique de puissance (UQAR)

Course Web site: Poly Website – www.moodle.polymtl.ca

Main Textbook: N. Mohan, T.M. Undeland, and W.P. Robbins, *Power Electronics: Converters, Applications, and Design,* Media Enhanced *Third Edition*, John Wiley & Sons, Inc., 2003, ISBN 0-471-22693-9

Alternate Textbook: M.H. Rashid, *Power Electronics: Converters, Devices and Applications,* Prentice Hall, 1993, ISBN 0-13-678996-X

Course Outline:

Objectives of the course

The course presents the operating principles of static power converters commonly used in practical industrial systems. It addresses the underlying concepts and methods behind various applications ranging from low-medium power utility interfaces to high power transmission systems. The main focus will be placed on the comprehension of the elementary power conversion structures, their operating principles, waveform analysis and dimensional aspects. Several practical examples will be given on renewable and alternate energy systems applications, power transmission and distribution system compensation and enhancement.

By the end of the course, the student is expected to:

- Understand the operating principles of static power converters and aspects of their application in electrical power systems.
- Be able to define the analytical expressions related to the operation of static power converters and to evaluate/compare the electrical performance of various options and topologies.
- Be able to carry on the basic analysis and specification of static power converters for specific applications.
- Be able to carry on simulation studies of a power electronic system.

Lecture :

Monday, 9:30 – 12:20 – Polytechnique Montréal – Pavillon Lassonde, Room L-2708
(First lecture: Monday, 29 August 2016)
(Last lecture: Monday, 5 December 2016)

Laboratory:

Polytechnique Montréal – Pavillon principal - Room A-328 & A-242
Group 1 – Every Monday: 13:45 - 16:35
Group 2 – Every other Monday: 13:45 – 16:35
Group 3 – Every other Monday: 16:45 – 19:35 (if necessary)
Lab demonstrator: Longcheng Tan
E-mail: Longcheng.tan@mail.mcgill.ca

Laboratory Work:

Laboratory experiments/simulations include:

- AC controllers – Three-phase industrial heating system
- Diode and thyristor AC-DC converters - static excitation system
- DC-DC converters – power supply and battery charging applications
- DC-AC converters – single phase inverters: SPWM techniques
- DC-AC converters – Applications: STATCOMs

Simulations are based on MATLAB & Simulink. MathCad or MATLAB are recommended for preliminary calculations and assignments. Laboratory reports are submitted per binomial group and are due two weeks after the scheduled laboratory period. Late reports may be turned in but are subject to a penalty of 10 points per extra day.

Assignments:

1. Introduction (Power Systems and Power Electronic Systems);
2. AC/AC Converters;
3. AC/DC Converters;
4. DC/DC Converters;
5. DC/AC Converters;
6. Utility Applications (HVDC, STATCOM);

- Assignments are posted on the course site, according to the schedule below;
- Solutions will be posted on course web site after the submission deadline;
- Assignments should be submitted by students within two weeks;
- Assignments are to be handed in individually and reflect individual work;

Grading Scheme:

Assignments	10 %
Laboratory reports	20 %
Mid-term exam	25 %
Final exam	45 %
Total	100 %

Academic conduct:

Academic dishonesty is not acceptable and will be *documented and punished*. Please do not ruin your career.

Professionalism:

Employers expect our graduates to behave like professionals.

- A professional is reliable – gets the job done on time.
- A professional has initiative – finds out what he/she does not know.
- A professional is respectful to others.

IGEE 401 – POWER ELECTRONIC SYSTEMS
Detailed schedule – Fall 2015
Polytechnique Montréal – Pavillon Lassonde - Room L-2708

Wk	Date	Topic	Chapter/ Sections R- alternate book	Assignments & Suggested problems P- main text book; R- alternate book	Laboratory Simul.: A-328 Exper.: A-242
1	29 Aug.	Introduction: Power electronic systems	1.1 – 1.7 , 3.1 – 3.2	P1-1, P1-3, P1-4, P3-6, P3-7	
2	12 Sept.	Power semiconductor switches & implementation techniques	2.1 – 2.12	***Assignment-1***	
3	19 Sept.	AC/AC converters (single phase and three phase)	6.2.1, 6.2.2, 16.3.3, 17.3.1, 17.2.4.2 R6.2, R6.4, R6.7	R6-1, R6-6, R6.8, R6-13 P17-5, P17-8 ***Assignment-2***	AC/AC converters feeding RL loads – 1-3 phase (Simulation)
4	26 Sept.	Line frequency ac-dc converters (diodes)	5.1, 5.2, 5.3.1, 5.3.4.2, 5.3.4.4, 5.5, 5.6.1, 5.6.4, 5.7, 5.9	P5-3, P5-4, P5-6, P5-23	
5	3 Oct.	Line frequency ac-dc converters (thyristors) - Ind applications	6.1, 6.2, 6.3.1, 6.3.4, 6.4.1, 6.4.3	P6-2, P6-5, P6-6, P6-13, P6-20***,*** ***Assignment-3***	AC-DC converters (Experimental)
	10-16 Oct.	**Fall Break**			
6	17 Oct.	DC-DC converters	7.1, 7.2, 7.3.1, 7.3.2, 7.3.4, 7.4.1, 7.4.2, 7.4.4, 7.7, 7.8, R9.6	P7-1, P7-2, P7-7, P7-8, P7.18	
7	24 Oct.	DC-DC converters. Applications **Midterm exam** (1 h 20 min)	**Exam on topics of weeks 1-5**	***Assignment-4***	DC-DC Converters (Simulation)
8	31 Oct.	DC-AC converters	8.1, 8.2, 8.3.	P8-1a, P8-10, P8-11	
9	7 Nov.	DC-AC converters. Industrial Applications	8.4.1, 8.4.2, 8.4.5, 8.7	***Assignment-5***	DC-AC converters (Experimental)
10	14 Nov.	Fundamentals of converter controls, filtering, power quality & EMC	8.6, 10.5.5, 18.1 – 18.6.	P18.2, P18.3	
11	21 Nov.	High power HVDC transmission	17.1, 17.2 (HVDC)	P17-2, P17-3	DC-AC rectifiers (Simulation)
12	28 Nov.	Utility applications – SVC, STATCOM and renewables	17.3.3, 8.6.3, 17.4, 17.5	P17-6 ***Assignment-6***	
13	05 Dec.	Practical exercises & revision			**Seminar – Power electronic applications (ABB)**
	(Dec.)	**Final exam**	All topics		

Note: The period for exams will take place from 7 to 22 December 2016, inclusive.