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

IGEE 401 – Power Electronic Systems (ELE8451)
(Dispositifs d'électronique de puissance)
Course Outline
Fall 2025

Course Instructor:

Professor Luiz A. C. Lopes, Concordia University
Office: Polytechnique Montréal, Pavillon principal, Room A-330.7
E-mail: luiz.lopes@concordia.ca
Office Hours: Monday, 13:30 – 16:00, Polytechnique Montréal, Room A-330.7

Equivalences:

ELEC 433	Power Electronics (Concordia)
ELE355	Électronique de puissance I (ÉTS)
GEL-4102	Électronique de puissance (Laval)
ECSE 465	Power Electronic Systems (McGill)
ELE8451	Dispositifs d'électronique de puissance (Polytechnique Montréal)
GEI 150	Électronique de puissance (Sherbrooke)
6GEI402	Électronique de puissance (UQAC)
GEN43109	Électronique de puissance (UQAR)
GEN4220	Électronique industrielle (UQAT)
GEN1663	Électronique de puissance (UQO)
GEI1063	Électronique de puissance (UQTR)

Course Website: www.moodle.*polymtl*.ca; browse ELE8451 – Dispositifs électronique de puissance

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 M-2201
(First lecture: Monday, 25 August 2025)
(Last lecture: Monday, 1 December 2025)

Laboratory: Polytechnique Montréal – Pavillon principal – Room A-328 and A-242
Groups 1 & 2 – Every other Monday: 13:45 – 16:40
Lab demonstrator: Mohammad Jafari-Matehkolaei
E-mail: mohammad.jafari-matehkolaei@polymtl.ca

Laboratory Work: Laboratory experiments/simulations include:

- AC-AC converters – 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 EMTP. MATLAB is 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 and AC-AC converters;
2. AC-DC converters;
3. DC-DC converters;
4. DC-AC converters;
5. Utility applications: HVDC and STATCOM.

Assignments are posted on the course site according to the schedule below. They should be submitted individually, and reflect individual work, within one week. Late assignments may be turned in with the same penalties as for the Lab reports. Solutions will be posted on the course web site. No assignments will be received after the solutions are posted.

Grading Scheme:

Assignments	10 %
Laboratory reports	20 %
Midterm 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 2025
Polytechnique Montréal – Pavillon Lassonde - Room M-2201

Wk	Date	Topic	Chapter/ Sections R- alternate book	Suggested problems P- main text book; R- alternate book	Laboratories and webinar
1	25 Aug.	Introduction: Power electronic systems	1.1 – 1.7 , 3.1 – 3.2	P1-1, P1-3, P1-4, P3-6, P3-7	
2	8 Sept.	Power semiconductor switches & implementation techniques Basic thyristor circuits and AC controllers (single phase)	2.1 – 2.12	**Assign. #1**	
3	15 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 P17-6, P17-8	AC-AC converters feeding RL loads – single phase & three phase (Simulation) **(group 1!)**
4	22 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 **Assign. #2**	**(group 2!)**
5	~~29 Sept.~~ 6 Oct.	Line frequency AC-DC converters (thyristors). Industrial 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	AC-DC converters (Experiment) **(group 2!)**
	13-19 Oct.	**Fall Break**			
6	20 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	27 Oct.	DC-DC converters. Applications **Midterm exam**	**Exam on topics of week 1-5** **Duration: 1h20 min**	**Assign. #3**	DC-DC converters (Simulation)
8	3 Nov.	DC-AC converters	8.1, 8.2	P8-1a, P8-10, P8-11	
9	10 Nov.	DC-AC converters. Applications	8.3, 8.4.1, 8.4.2, 8.4.5, 8.7		DC-AC converters (Experiment)
10	17 Nov.	Fundamentals of converter controls, filtering, power quality and EMC.	8.6, 10.5.5, 18.1 – 18.6.	P18.2, P18.3 **Assign. #4**	
11	24 Nov.	High power HVDC transmission	17.1, 17.2 (HVDC)	P17-2, P17-3 **Assign. #5**	DC-AC converters (Simulation)
12	1 Dec.	Utility applications: SVC, STATCOM and renewables	17.3.3, 8.6.3, 17.4, 17.5	P17-6 ~~**Assign. #5**~~	**Seminar GE Vernova** Martin Le François
13	**3** Dec. **M-2203**	Practical exercises & Revision			**Visit & SeminarABB** **(Confirmed. See course web site.)**
	7 Dec	**Final exam**	**Topics: Up to (including) lecture 11. Room A-604, 9:30 hs to 12:00 hs**		