
Course Information

POLYTECHNIQUE
MONTRÉAL

LE GÉNIE
EN PREMIÈRE CLASSE



ELE8451 - Power Electronic Systems - IGEE 401

Course offered by the
Department of Electrical Engineering
Fall 2024

Course website located at [Moodle](#)
Last Update : 21 août 2024

Course Instructor

Name	Professor Amin Ghazanfari
Office	Polytechnique Montréal, Pavillon principal, Room A-330.7
Email	amin.ghazanfari@polymtl.ca
Office hours	by email appointment

Lecture

Monday, 9 :30 - 12 :20 - Polytechnique Montréal, Pavillon Lassonde, Room M-2201
(First lecture : Monday, 26 August 2024)
(Last lecture : Monday, 2 December 2024)

Laboratory

Groups 1 & 2 Every other Monday : 13 :45 - 16 :40, Polytechnique Montréal, Pavillon principal - Room A-328 and A-242

Course Description

The course presents the operating principles of 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. By the end of the course, the student is expected to :

- Understand the operating principles of power converters and aspects of their application in electrical power systems.
- Describe the analytical expressions related to the operation of power converters and evaluate/compare the electrical performance of various options and topologies.
- Perform basic analysis and specification of static power converters for specific applications.
- Model and control of DC/DC converters and voltage-source converters (VSCs).
- Carry on simulation studies of a power electronic system.

Course Prerequisites

- Basic understanding of power electronics, power systems and control theory.
- Familiarity with a programming language and/or a simulation package such as MATLAB/Simulink or EMTP.

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)

Resources

Reference books are useful for deepening the theoretical material taught during class sessions.

1. ELE8451 - Lecture Notes (slides). Available on [Moodle](#).
2. ([Main Textbook](#)) N. Mohan, T. Undeland and W. Robbins *Power Electronics Converters, Applications and Design*. John Wiley & Sons, 2003, ISBN 0-471-22693-9.
3. ([Alternate Textbook](#)) M.H. Rashid, *Power Electronics : Converters, Devices and Applications*, Prentice Hall, 1993, ISBN 0-13-678996-X.

Evaluation

Nature	Weighting (%)
Assignment	10%
Laboratory reports	20%
Midterm Exam	25%
Project (Bonus)	10%
Final Exam	45%

The final grades will be assigned based on the relative standing of the class in terms of overall performance.

Policies on Missed Examinations In the event of a duly justified absence from the final exam, student may be granted the privilege of a deferred exam from the Deans Office. Students missing the final exam will have to take up the matter with the Deans Office, who then advises instructors if a deferred or re-exam is to be provided. If granted, time and location will be determined by the Instructor in consultation with the department of Electrical Engineering.

Academic Integrity

Academic honesty

- If cheating/plagiarism is suspected, instructors are required to meet with student(s) to discuss the matter and hand all information to the Dean's office.
- Possible Sanctions : reduction of grade, fail in a course, a remark on a transcript, expulsion, suspension

ELE8451 Implementation

- Assignments and projects are to be completed independently.
- Peer discussion of the best approach to solve problems is encouraged.
- Direct copying of someone else's work is plagiarism.

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.

Detailed Schedule

Wk	Date	Topic	Chapter/Sections R- alternate book	Suggested Problems P- main text book ; R- alternate book	Laboratories
1	26 Aug	Introduction : Power electronic systems	1.1 - 1.7 , 3.1 - 3.2	P1-1, P1-3, P1-4, P3-6, P3-7	
2	9 Sept	Power semiconductor switches & implementation techniques Basic thyristor circuits and AC controllers (single phase)	2.1 - 2.12	Assign. #1	
3	16 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 â single phase & three phase (Simulation)
4	23 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	
5	7 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)
	12-18 Oct	Fall Break			
6	21 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	28 Oct	DC-DC converters Applications Mid-term exam	Exam on topics of week 1-5 Duration : 1h20 min	Assign. #3	DC-DC converters (Simulation)
8	4 Nov	DC-AC converters	8.1, 8.2	P8-1a, P8-10, P8-11	
9	11 Nov	DC-DC converters Applications	8.3, 8.4.1, 8.4.2, 8.4.5, 8.7		DC-AC converters (Experiment)
10	18 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	25 Nov	High power HVDC transmission	17.1, 17.2 (HVDC)	P17-2, P17-3	DC-AC converters (Simulation)
12	2 Dec	Utility applications : SVC, STATCOM and renewables	17.3.3, 8.6.3, 17.4, 17.5	P17-6 Assign. #5	

— Note : The period for exams will take place from December 5th to 20th, 2024 inclusive.