



IGEE 418 – Electric Power Generation (Production de l'énergie électrique)

Course Outline Winter 2018

Instructors :

Prof. François Bouffard, P.Eng.
Office: McGill University, McConnell Engineering Building, Room 642
Telephone: (514) 398-2761
E-mail: francois.bouffard@mcgill.ca

Office Hours: Monday afternoons, Polytechnique Montréal, Room A-330.5 or by appointment

Equivalences :

ECSE 463 Electrical Power Generation (McGill University)
ELE 8461 Production de l'énergie électrique (Polytechnique Montréal)
ELEC 498F Electrical Power Generation (Concordia University)
GEL 3010 Production de l'énergie électrique (Université Laval)

Prerequisites :

A basic course in power system analysis and electromechanical energy Conversion. You should have a basic familiarity with: ac circuit analysis, three-phase systems, basic electromagnetic and electromechanical energy conversion devices.

References:

A. J. Wood & B. F. Wollenberg (1996). *Power Generation Operation and Control*, 2nd ed., New York, NY: Wiley.

G. A. Munoz-Hernandez, S. P. Mansoor & D. I. Jones (2013). *Modelling and Controlling Hydropower Plants*. London: Springer-Verlag.

J.-C. Sabonnadière, ed. (2010). *Renewable Energy Technologies*. John Wiley and Sons.

J. Pyrhonen. (2008). *Design of Rotating Electrical Machines*, Wiley-Inter-Science – Blackwell.

G. C. Stone, E. A. Boutler, I. Calbert & H. Dhirani. (2004). *Electrical Insulation for Rotating Machines Design, Evaluation, Aging, Testing, and Repair*. John Wiley and Sons, IEEE Press.

S. Heier. (2006). *Grid Integration of Wind Energy Conversion Systems*. 2nd ed. Wiley Inter-Science.

Lectures :

Polytechnique Montréal, Pavillon Lassonde – Room M-2004
Monday: 9:30 – 12:20

Laboratory :

Polytechnique Montréal, Pavillon Principal – Room A-328
Contact: Ms. Navdeep Dhaliwal
E-Mail: navdeep.dhaliwal@mail.mcgill.ca

Course Website : www.moodle.polymtl.ca; browse for ELE 8461, Production de l'énergie électrique
Note: the course website should be used for all communications and questions regarding the course and coursework.

Course Outline : Objectives of the course

The goal of this course is to introduce the fundamental principles and challenges arising in power generation.

The specific course objectives are:

- To understand the principles of operation of electrical power generators and related energy storage assemblies
- To understand the structure and principles of the controls related to electrical power generators and generating stations
- To understand the principles governing the design and sizing of electrical generators
- To understand the principles behind the protection methodologies applicable to electrical generating stations and particularly the generators themselves
- To understand the principles governing generation dispatch, including management of hydro reservoirs and generating units
- To understand the standards governing the integration of electrical power generators to the power grid (grid codes)
- To understand the standards governing the interconnection of dispersed electrical power generation to the power grid (interconnection standards)

Topics covered

- Energy sources
- Principles of design, operation and control of synchronous generators
- Principles of operation and control of wind and solar generators
- Generation planning
- Generating station grid interconnection

<u>Grading Scheme</u> :	Assignments (4)	25 %
	Laboratory reports (3)	15 %
	Mid-term examination	20 %
	Final examination	<u>40 %</u>
	Total	100 %

Laboratory : Work using computer simulations covers the following topics and applications:

- Design procedures for large hydro generators
- Operation and control of synchronous generators – Frequency and voltage controllers
- Wind turbine generators – Operation and controls

Laboratory instructions will be available for download from the course website. Students are to work in pairs, and each laboratory team will hand in a single report. Students in the team will receive the same grade.

Laboratory reports are due one week after the scheduled laboratory period.

Assignments : Assignments will be made available for download about every fortnight. Assignments have to be submitted individually. Assignments will be due within one week.

**IGEE 418 – ELECTRICAL POWER GENERATION
 Detailed Schedule – Winter 2018**

Wk	Date	Topic	Inst.	Assignments	Laboratories, seminars, ind. visits
1	8 Jan.	Prime energy sources – Conventional and renewable	FB		
2	15 Jan.	Characteristics and operation of hydro generators	FB	Assignment 1 - Energy sources and electric power production	Seminar 1 - Introduction to hydrogeneration plants (HQ Production – Éric Lambert)
3	22 Jan.	Synchronous generators – Steady state operation & modelling I	FB		Lab 1 - Design procedures for large hydro generators
4	29 Jan.	Synchronous generators – Steady state operation & modelling II	FB		Seminar 2 –Introduction to Preliminary Design, Manufacturing and Erection of Hydro Generators (GE – Mohammed El-Kahel)
5	5 Feb.	Synchronous generators – Frequency and voltage control	FB	Assignment 2 - Synchronous generator operation and control	Lab 2 - Operation and control of synchronous generators – Frequency and voltage controllers
6	12 Feb.	Static power converters – Principles of operation as grid-connected generators	FB		Seminar 3 - Advanced synchronous generator controls (HQ Production – Éric Lambert)
7	19 Feb.	Principles of wind energy conversion and systems	FT	Assignment 3 - Static power converter operation	Industrial visit 1 – Parc éolien Pierre-de-Saurel (PEPdS – Fred Tremblay)
8	26 Feb.	Operation and control of grid-connected renewable generation	FB		
	5 Mar.	Study break			
9	12 Mar.	Midterm examination	FB		Lab 3 - Wind turbine generators – Operation and controls
10	19 Mar.	Energy storage systems and their role in renewable energy integration	FB		
11	26 Mar.	Distributed generation interconnection and grid codes	FB		Industrial visit 2 -Centrale Beauharnois (HQ Production – Éric Lambert)
12	9 Apr.	Generation operations planning	FB	Assignment 4 – Hydrogeneration planning and storage management	Seminar 4 - Integration of bulk generation into the electric grid (HQ TransÉnergie – Noël Aubut)
13	16 Apr.	Energy system integration	FB		
	TBA	Final Exam	Exam on all topics		

Note : The period for exams will take place from April 20th to May 4th, 2018 inclusive.