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

IGEE 418 - ELE8461 – Electrical Power Generation
(Production de l'énergie électrique)

Course Outline
Winter 2021

Instructors: Professor François Bouffard, P.Eng.
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Office Hours: Virtual, by appointment; information to book appointments will be provided on Moodle.

Equivalences:

ECSE 463	Electrical Power Generation (McGill University)
ELE8461	Production de l'énergie électrique (Polytechnique Montréal)
ELEC 446	Electrical Power Generation (Concordia University)
ELE760	Production de l'énergie électrique (École de technologie supérieure)
GEL-3010	Production de l'énergie électrique (Université Laval)
6GEI715	Production de l'énergie électrique (UQAC)
GEN44718	Production de l'énergie électrique (UQAR)
GEN1863	Production de l'énergie électrique (UQO)

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, l. 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: Online, using the Zoom online meeting platform; lectures will be live and recorded; links to join the lecture will be provided by the instructor on Moodle
Monday: 9:30 – 12:20, Montreal time

Laboratory: Online, using the Zoom online meeting platform; remote lab access instructions will be provided on Moodle
As per the schedule attached: 13:45 – 16:40
Teaching assistant: Mr. Thibault Leyne
E-mail: thibault.leyne@mail.mcgill.ca

Course Website : www.moodle.polymtl.ca; browse for ELE 8461, Production de l'énergie électrique

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 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

Grading Scheme:

Assignments (4)	35%
Laboratory reports (3)	15 %
Midterm examination	20 %
Final examination	40 %
Total	**100 %**

The midterm and final examinations will be run as take-home examinations. Students will have 48 hours to complete the work. Students will be encouraged to resort to computational resources in answering examinations.

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.

IGEE 418 – ELECTRICAL POWER GENRATION
Detailed Schedule –Winter 2021

Wk	Date	Topic	Inst.	Assignments	Laboratories, seminars, ind. visits
1	18 Jan.	Prime energy sources – Conventional and renewable	FB	**Assignment 1 -** Energy sources and electric power production	
2	25 Jan.	Characteristics and operation of hydro generators	FB		**Seminar 1**- Introduction to hydrogeneration plants **(HQ Production – TBA)**
3	1 Feb.	Synchronous generators – Steady state operation & modelling I	FB		**Lab 1 -** Design procedures for large hydro generators
4	8 Feb.	Synchronous generators – Steady state operation & modelling II	FB	**Assignment 2 -** Synchronous generator operation and control	
5	15 Feb.	Synchronous generators – Frequency and voltage control	FB		
6	22 Feb.	Static power converters – Principles of operation as grid-connected generators	FB		**Lab 2** - Operation and control of synchronous generators – Frequency and voltage controllers
	1 Mar.	**Study break**			
7	8 Mar.	Principles of wind energy conversion and systems	FT	**Assignment 3** - Static power converter operation	**Seminar 2** - Advanced synchronous generator controls **(HQ Production – TBA)**
8	15 Mar.	Operation and control of grid-connected renewable generation	FB		**Lab 3** – Control of wind turbine generators
9	22 Mar.	**Midterm examination**			
10	29 Mar.	Energy storage systems and their role in renewable energy integration	FB		**Seminar 3** – Solar farm engineering **(CIMA+ – Éric Cantin)**
11	12 Apr.	Hydrogeneration operations planning	FB	**Assignment 4** – Hydrogeneration planning and storage management	
12	19 Apr.	Distributed generation interconnection and grid codes	FB		~~**Seminar 4 -** Integration of bulk generation into the electric grid~~ **(Cancelled)**
	TBA	**Final Exam**	Exam on all topics		

Note: *The period for exams will take place from April 23rd to May 7th, 2021 inclusive.*