OCIECE Graduate Course

Renewable and Distributed Energy Resource Technologies

(ELEC 5302 - 2024 Fall Term)

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Course Objectives:

Renewable energy technologies, together with advances in energy efficiency, are being used globally to reduce greenhouse gas emissions and to relieve the energy crisis brought on by the depletion of fossil fuels. Representing a growing part of the smart grid model for the electric power industry, renewable and distributed generation units including photovoltaic (PV) panels, wind turbines, energy storage devices, and so on will be connected to the power systems in increasing numbers. They are used as an alternative to or an enhancement of the traditional electric power grid to provide high-quality, reliable electricity at the utility customer sites. Renewable and distributed energy resource technologies may also be beneficial in delaying electric utility infrastructure upgrades.

This course introduces the fundamentals and applications of renewable and distributed energy resource technologies with a focus on photovoltaic generation, wind generation, battery storage, distributed generation and micro-grid. The main objectives of the course are:

(1) to help students gain a thorough understanding of the basic concepts and techniques of renewable and distributed energy resource technologies;
(2) to provide students with the fundamental knowledge and analytical skills necessary to design sustainable energy systems connected to the main power grid;
(3) to enable students to acquire hands-on experience on modeling and simulation of renewable and distributed energy resource systems;
(4) to train students to conduct independent research in the area of renewable energy.

By the end of the course students should be able to:

(1) understand and master principles of the focused renewable energy generation systems, i.e., photovoltaic, wind, and battery storage;
(2) analyze and simulate the detailed computer simulation models of the focused renewable energy generation systems;
(3) investigate the interconnection (to the main power grid) issues caused by renewable energy generation systems;
(4) review literature, identify questions, propose solutions, and deliver results in the research area of renewable energy generation.

Course Schedule:

Lectures: Monday 11:35 pm-2:25 pm ME4124

Tentative schedule	Lecture
	Monday
Week 1	No class
Week 2	
Week 3	
Week 4	
Week 5	
Week 6	
Week 7	
Week 8	Break
Week 9	
Week 10	
Week 11	
Week 12	
Week 13	
Week 14	

Reference material

1. Course lecture notes and slides:
2. Supplementary textbooks:
   [1] Stephen J. Chapman, Electric machinery fundamentals, McGraw-Hill, Fifth Edition, 2011.
   [2] Glover, Sarma, and Overbye, Power systems analysis and design, Fifth Edition, Thomson, 2011.
   [3] Mohan, Undeland and Robbins, Power electronics, converters, applications and design, Third Edition, ISBN 978-0-471-22693-2
   [4] Gonzalo Abad, Jesús López, Miguel Rodríguez, Luis Marroyo, and Grzegorz Iwanski, Doubly fed induction machine: modeling and control for wind energy generation, ISBN: 978-0-470-76865-5, Wiley-IEEE Press, October 2011.
   [5] Math Bollen and Fainan Hassan, Integration of distributed generation in the power system, ISBN: 978-0-470-64337-2, Wiley-IEEE Press, July 2011.
   [6] Djamila Rekioua and Ernest Matagne, Optimization of photovoltaic power systems: modelization, simulation and control, ISBN: 978-1-4471-2348-4, Springer, 2012.
   [7] S. Chowdhury, S. P. Chowdhury and P. Crossley, Microgrids and active distribution networks, ISBN: 978-1-84919-014-3, the Institution of Engineering and Technology, 2009.

Brightspace:

Brightspace will be used for communication and posting of course material, including lecture slides. The Brightspace site can be accessed from https://brightspace.carleton.ca/d2l/home .

Please refer to the Brightspace site frequently in order to keep up-to-date with the course material that is posted there.

Marking Scheme:

Mid-term 1	25 %
Mid-term 2	25 %
Final Project	50 %

Note:

1. The mid-term exams will be open book.
2. The requirement on the course project will be provided separately.
3. The computer simulation tool Matlab/Simulink-SimPowerSystems will be needed to do the assignment, the mid-term exam, the project, and the final exam. The computers in the following labs at Carleton University have the license for Matlab/Simulink-SimPowerSystems: Canal Building 3104 (Ottawa Hydro Lab), Mackenzie Building (ME4128, ME4166), Minto Center (MC6030).

Lecture Topics: The list below indicates possible topics covered in the course.

Week 1	Introduction and power system basics
Week 2	Photovoltaic systems
Week 3	Photovoltaic systems
Week 4	Wind generation systems
Week 5	Wind generation systems
Week 6	Midterm 1
Week 7	**Winter Break, University closed**
Week 8	Electric vehicle
Week 9	Energy storage units
Week 10	Distributed generation protection
Week 11	Midterm 2
Week 12	Microgrid
Week 13	Microgrid
Week 14	Microgrid

Academic Accommodation

You may need special arrangements to meet your academic obligations during the term. For an accommodation request the processes are as follows:

Pregnancy obligation: write to me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details see the Student Guide

Religious obligation: write to me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details see the Student Guide

Academic Accommodations for Students with Disabilities: The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or pmc@carleton.ca for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send me your Letter of Accommodation at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). After requesting accommodation from PMC, meet with me to ensure accommodation arrangements are made. Please consult the PMC website for the deadline to request accommodations for the formally-scheduled exam (if applicable).

You can visit the Equity Services website to view the policies and to obtain more detailed information on academic accommodation at http://www.carleton.ca/equity/