ENGS9BC.T ELECTRIC ENERGY MANAGEMENT

ENGS9BC.T **Electric Energy Management -** **Integration of renewable energies**	**Crédits :** 2 ECTS **Durée :** 21 heures	**Semestre :** S9

Persons in charge:

Serge Pierfederici professor,

Jean-Philippe Martin & Stéphane Dufour associated professor

Keywords:

Renewable energy, photovoltaic applications, wind generator, power electronics, grid code, power energy management

Prerequisites: Génie électrique

Objectives:

Introduce electrical models of photovoltaic and wind generators. Introduce power electronic converters used to transfer energy from renewable energy sources to the grid and their associated control

Program and contents:

1. ***Practical lab dealing with power measurement in AC grids (S. Dufour)*** **3h TP**

   Power measurement in AC grid: measure of active and reactive power for various loads

   Studies of the transient response due to load or power disconnection

2. ***Electrical model of photovoltaic cell, PV modeling for simulation and control*** **1h C 2h TD**

   The PV cells electrical models are presented. The use of Lambert function for PV systems simulation purpose is introduced. Maximum Power Point tracking (MPPT) algorithms are presented (Perturb&Observe, conductance methods) with their associated power converter. A complete simulation realized with Matlab/Simulink including PV modeling, power electronic converter and MPPT algorithm will be developed by the students.

3. ***PV Power generation to the grid -*** **2h C 4h TD**

   An introduction to the transfer of power between voltage generators is presented. The PV power plant architecture, injection of power into the 3-phases AC grid and constraints is then introduced. The grid code constraints are finally discussed. A complete simulation of PV plant realized with Matlab /Simulink including PV modeling, power electronic inverter, Power injection to the grid will be developed by the students in two parts. The first one deals with the control of the active and reactive powers injected to grid and the second one details the MPPT algorithm implementation in the PV plant case.

4. ***Electrical models of synchronous generator and Power Generation to the grid*** **2h C 4h TD**

   The electrical models of synchronous generators with their associated power architectures ('back to back') are presented. Their modeling in dq-frame is introduced. Control of the power flow is presented. A complete simulation of a wind generator realized with Matlab/Simulink including Permanent Magnet Synchronous Machine modeling, power electronic inverter and power injection to the grid will be developed by the students.

5. ***Electrical models of induction generator and Power Generation to the grid*** **1h C 2h TD**

   Power electronic topology will be presented. The classical model in dq frame of the complete system is defined. Its associated power flow management are presented. A complete simulation of an induction machine system will be given and finalized by the students.

Abilities :

Levels	Description and operational vocabulary
Know	
Understand	
Apply	
Analyze	
Summarize	
Assess	

Evaluation :

☑ Written test	☐ Continuous assessment	☐ Oral presentation	☐ Project	☐ Written report