2SC7810 – Renewable energies and micro grids

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Department: CAMPUS DE RENNES
Language of instruction: ANGLAIS
Campus: CAMPUS DE RENNES
Workload (HEE): 60
On-site hours (HPE): 34,50

Description

Faced with the negative environmental impacts of any energy production and the depletion of fossil resources, the transition to renewable sources is a profound trend. While renewable energies provided only 25% of the world's electricity production in 2018, this share is growing rapidly, with a threefold increase over 10 years in wind and solar energy.

These new energies raise specific questions to be addressed in this course:

- What are the wind and solar resources and the main principles of their conversion into electricity?
- What are the storage technologies, in particular batteries, that can manage the variability of these sources?
- What are the technical, environmental and economic challenges of these technologies?

In addition, wind and solar energy are much more *decentralized* than conventional thermal power plants. Thus, electricity production is moving closer to consumption areas, which leads to the emergence of the notion of "microgrid", similar to short food supply chains (SFSCs).

A microgrid is a small electrical system that integrates production and consumption within a delimited area (building, district, island, etc.) and is equipped with a local energy flow management system. A microgrid can be stand-alone or connected to a large network. If connected, it acts as a unique and intelligent actor, able, for example, to buy electricity from the wholesale market at the best moments or to provide grid services. The integration of all these components and functions raises system optimization issues that are covered in this course.

Due to their small size, the issue of reliability is an important one for microgrids. This course aims to study the methods of *dependability* to analyze the risks of failure, plan maintenance and react to outages…

Quarter number
ST7

Prerequisites (in terms of CS courses)
None

Syllabus

Renewable energies (REn) and storage :

- Solar, wind, hydroelectric, bio-mass,...
- Modeling and predictability of production
- flexibility, storage technologies

Micro grids :

- Electrical grid architecture and modeling
- Sizing and operational management: taking into account the impacts of renewable energies, Quality of Service (voltage, frequency, etc.)

Reliability of grids:

- Reliability indicies
- Security bdies
- Reconfigurability
- Failure and reliability of components

Economic models of micro grids:

- Investment plan, profitability
- Uncertainties and risk management
- Energy markets, price signal, trading

Class components (lecture, labs, etc.)
Lecture (~50%): Exercise/labs (~50%)

Grading
written examination 1h30 - (70%) continuous assessment (30%)

Resources
lecture, labs.
This course contains lectures and a large part of labs.

Learning outcomes covered on the course

At the end of this course, students will be able to :

- Understand the economical, ecological and societal context of microgrids
- Identify and characterize the different energy production sources and energy storages.
- Size a microgrid with different energy sources and energy storage, taking into account technical/non-technical constraints and uncertainties.
- evaluate system performances and system dependability.

Description of the skills acquired at the end of the course

- Understand the economical, ecological and societal context of microgrids. C1.1
- Identify and characterize the different energy production sources and energy storages C2.1
- Size a microgrid with different energy sources and energy storage, taking into account technical/non-technical constraints and uncertainties. C2.1