Last update: 08-05-2019

820752 - GEPFR - Power Generation From Renewable Energy Sources

Coordinating unit: 240 - ETSEIB - Barcelona School of Industrial Engineering

Teaching unit: 709 - EE - Department of Electrical Engineering

Academic year: 2019

Degree: MASTER'S DEGREE IN ENERGY ENGINEERING (Syllabus 2013). (Teaching unit Optional)
MASTER'S DEGREE IN ENERGY ENGINEERING (Syllabus 2013). (Teaching unit Optional)

ECTS credits: 5 Teaching languages: Catalan, English

Teaching staff

Coordinator: ORIOL GOMIS BELLMUNT

Others: Segon quadrimestre:
ORIOL GOMIS BELLMUNT - T10

Prior skills

Electrical systems. Electric Machines. Electrical Engineering.

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Teaching methodology

Teaching methodology:

The course teaching methodologies are as follows:

- Lectures and conferences: presentation of knowledge by lecturers or guest speakers.
- Participatory sessions: collective resolution of exercises, debates and group dynamics, with the lecturer and other students in the classroom; classroom presentation of an activity individually or in small groups.
- Theoretical/practical supervised work (TD): classroom activity carried out individually or in small groups, with the advice and supervision of the teacher.
- Homework assignment of reduced extension: carry out homework of reduced extension, individually or in groups.
- Homework assignment of broad extension: design, planning and implementation of a project or homework of broad extension by a group of students, and writing a report that should include the approach, results and conclusions.
- Evaluation activities (EV).

Training activities:

The course training activities are as follows:

- Face to face activities
o Lectures and conferences: learning based on understanding and synthesizing the knowledge presented by the teacher or by invited speakers.
o Participatory sessions: learning based on participating in the collective resolution of exercises, as well as in discussions and group dynamics, with the lecturer and other students in the classroom.
o Presentations (PS): learning based on presenting in the classroom an activity individually or in small groups.
o Theoretical/practical supervised work (TD): learning based on performing an activity in the classroom, or a theoretical or practical exercise, individually or in small groups, with the advice of the teacher.

- Study activities
o Homework assignment of reduced extension (PR): learning based on applying knowledge and presenting results.
o Homework assignment of broad extension (PA): learning based on applying and extending knowledge.
o Self-study (EA): learning based on studying or expanding the contents of the learning material, individually or in groups, understanding, assimilating, analysing and synthesizing knowledge.

Learning objectives of the subject

Electrical aspects of renewable energy will be addressed, from the modelling and control of the required electrical machines to electrical grid integration issues.
1. Introduce the generation principles of the different renewable sources.
2. Introduce the different renewable energy sources focusing on photovoltaic solar and wind systems.
3. Delve into the the electrical aspects of the treated energy sources: induction and synchronous generators, PV panels, etc.
4. Work with energy conversion technologies to integrate renewable energies into the electrical grid or microgrid.
5. Focus on control techniques to maximise generation and control optimally the grid interconnection.
6. Analyse issues related to grid integration: voltage and frequency stability, effect of perturbations into the renewable source generation, etc.
7. Development of simulation-based exercises.

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Study load

Total learning time: 125h	Hours small group:	30h	24.00%
	Guided activities:	15h	12.00%
	Self study:	80h	64.00%

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Content

Introduction and context of renewable electricity generation

Learning time: 5h

Theory classes: 2h
Self study : 3h

Description:
A global introduction to the course will be given covering all the main aspects related to renewable energy generation. The different generation principles will be introduced. Methodologies to conduct technical-economical studies will be presented. Design and sizing methodologies will be exposed. Modelling and analysis techniques will be described.

Specific objectives:
Introduction and context of the course.

Wind generation

Learning time: 57h

Theory classes: 6h
Practical classes: 7h
Guided activities: 7h
Self study : 37h

Description:
Wind power. Principles and basic elements.
Analysis of configurations of terrestrial and marine wind farms.
Electric machines for wind: induction generator and synchronous generator.
Converters used.
Control of wind turbines and wind farms.

Related activities:
Activity 1

Specific objectives:
Introduce the principles of wind generation.
Deepen knowledge of the electrical aspects: induction and synchronous electric generators and converters.
Deepen knowledge of control techniques to maximise the generation and optimally control the grid connection.

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Solar photovoltaic generation	Learning time: 24h Theory classes: 3h Self study : 21h

Description:
Principles and basic elements.
Photovoltaic panels. Techniques of grouping. Converters.
Monitoring photovoltaic systems.

Specific objectives:
Introduce the principles of photovoltaic solar generation.
Deepen knowledge of the electrical aspects: panels and converters.
Deepen knowledge of control techniques to maximise the generation and optimally control the grid connection.

Network integration of renewable generation	Learning time: 39h Theory classes: 4h Practical classes: 8h Guided activities: 8h Self study : 19h

Description:
Introduction to the electricity system with the presence of renewables.
Grid codes.
Grid support with renewables.
Microgrids and supergrids.

Related activities:
Activity 2

Specific objectives:
Introduce the principles of integration of renewable generation to the grid.
Understand codes and support of the grid necessary with strong penetration of renewables.

Qualification system

Written test (PE). 50%
Work performed individually or in groups (TR). 50%

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Bibliography

Complementary:

Ackermann, Thomas. Wind power in power systems. 2nd ed. Chichester ; Hoboken, N.J.: Wiley, 2012. ISBN 978-0470974162.

Manwell, J.F. [et al.]. Wind energy explained : theory, design and application [on line]. 2nd ed. [Chichester]: John Wiley & sons, 2010 [Consultation: 12/09/2017]. Available on: <http://site.ebrary.com/lib/upcatalunya/docDetail.action?docID=10419452>. ISBN 9780470686287.

Jenkins, Nick. Embedded generation [on line]. London: The Institution of Electrical Engineers, cop. 2000 [Consultation: 10/10/2016]. Available on: <http://site.ebrary.com/lib/upcatalunya/docDetail.action?docID=10263818>. ISBN 9780852967744.

Freris, L. L; Infield, D. G. Renewable energy in power systems. Chichester, U.K.: John Wiley & Sons, 2008. ISBN 9780470017494.