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820156 - GEO - Wind Energy Generation

Coordinating unit: 295 - EEBE - Barcelona East School of Engineering

Teaching unit: 709 - EE - Department of Electrical Engineering

Academic year: 2017

Degree: BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN ENERGY ENGINEERING (Syllabus 2009). (Teaching unit Optional)

ECTS credits: 6 Teaching languages: Catalan, Spanish

Teaching staff

Coordinator: SERGIO RATÉS PALAU

Others: Primer quadrimestre:
SERGIO RATÉS PALAU - T11, T12

Degree competences to which the subject contributes

Specific:

1. Understand the applications of renewable energies.

Teaching methodology

- In the theory classes, will be exposed and develop the theoretical foundations of programmed materials. They consist of theoretical explanations complemented by activities to encourage participation, discussion and critical analysis by students.
- In the classes of problems will arise and solve exercises related to the matters. Students should meet individually or in groups, indicating problems.
Within hours, students will conduct laboratory practices as required and submit the relevant report of the activity along with appropriate calculations and critical considerations.
-Will work in groups during the course of a specific topic related to the subject.

Learning objectives of the subject

- Understand the different technologies of wind generation of electricity.
- Know how to determine the location of wind resources.
- Understand the different possibilities of control of wind turbines.
- Understand its operation in the power system.
- Know how to model, simulate and analyze the different parts and the whole farm system.
- Learn to perform a pre-dimensioning of wind systems.

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Study load

Total learning time: 150h	Hours large group:	45h	30.00%
	Hours medium group:	0h	0.00%
	Hours small group:	15h	10.00%
	Guided activities:	0h	0.00%
	Self study:	90h	60.00%

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Content

1. - General Concepts

Learning time: 10h

Theory classes: 3h
Laboratory classes: 1h
Self study : 6h

Description:
1.1 Overview of Wind Energy Conversion Systems (WECS)
1.2 Wind Energy technology
1.3 WECS configurations
1.4 Grid Code

2.- The wind resource.

Learning time: 20h

Theory classes: 6h
Laboratory classes: 2h
Self study : 12h

Description:
2.1 General concepts.
2.2 Variation in height and space
2.3 Variability of wind in time
2.4 Determination of gross energy yield
2.5 Assessment of resources
2.6 Wind measurements
2.7 Special offshore effects

3.- Fundamentals of wind energy conversion system control

Learning time: 20h

Theory classes: 6h
Laboratory classes: 2h
Self study : 12h

Description:
3.1 Wind turbine aerodynamics
3.2 Maximum power point tracking (MPPT) control
3.3 Wind turbine components

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4.- Wind generators and modelling	Learning time: 20h Theory classes: 6h Laboratory classes: 2h Self study : 12h

Description:
4.1 Reference frame transformations
4.2 Induction generator models
4.3 Synchronous generators

5.- Power Converters in wind energy conversion systems	Learning time: 20h Theory classes: 6h Laboratory classes: 2h Self study : 12h

Description:
5.1 Two-level voltage source converters
5.2 Three-level neutral point clamped converters
5.3 Comparison 2-level and 3-level converters
5.4 Converter control

6.- Wind Energy Conversion System Configuratios	Learning time: 20h Theory classes: 6h Laboratory classes: 2h Self study : 12h

Description:
6.1 Fixed speed WECS
6.2 Variable speed induction generator WECS
6.3 Variable speed synchronous generator WECS

7.- Wind Farm Layout	Learning time: 20h Theory classes: 6h Laboratory classes: 2h Self study : 12h

Description:
7.1 Wind Farm layout design
7.2 Electrical grid collector design
7.3 Wind farm connected to High voltage alternative current (HVAC)
7.4 Wind farm connected to High Voltage direct current (HVDC)

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8.- Grid Integration	Learning time: 10h Theory classes: 3h Laboratory classes: 1h Self study : 6h

Description:
8.1 Power system concepts
8.2 Wind power variability and limited predictability
8.3 Grid Codes for Wind Turbines
8.4 Grid Code requeriments

Qualification system

- Work practices done during the course (50%)
- Test done at the end (35%)
- Realization of problems individually at laboratory (15%)

Regulations for carrying out activities

-The written tests are face and individual.
-In the classes of problems and / or laboratory practices will be assessed, where appropriate, the prior work with the presentation of results of each activity.

Bibliography

Basic:

Stiebler, Manfred. Wind energy systems for electric power generation. Berlin: Springer, cop. 2008. ISBN 9783540687627.

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Wind power in power systems. Chichester: John Wiley & Sons, cop. 2005. ISBN 0470855088.

Heier, Siegfried. Grid integration of wind energy conversion systems. 2nd ed. Chichester [etc.]: John Wiley & Sons, cop. 2006. ISBN 0470868996.

Complementary:

Lubosny, Zbigniew. Wind turbine operation in electric power systems : advanced modeling. Berlin [etc.]: Springer, 2003. ISBN 354040340X.

Teodorescu, Remus. Grid converters for photovoltaic and wind power systems. Chichester, West Sussex: John Wiley & Sons, 2011. ISBN 9780470057513.

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