66336 - Power quality and grid integration

Información del Plan Docente

Academic Year	2016/17
Academic center	110 - Escuela de Ingeniería y Arquitectura
Degree	535 - Master's in Renewable Energies and Energy Efficiency
ECTS	5.0
Course	1
Period	Second semester
Subject Type	Optional
Module	---

1.Basic info

1.1.Recommendations to take this course

The student must have knowlege on electricity and electrical networks as well as various cross-disciplinary knowlege. Specifically:

- Advanced knowledge on circuit theory, electrical machines and electrical networks.
- Basic knowledge on power electronics based control systems.
- Capability for autonomous looking up technical and scientific databases.
- Good english level for reading technical documentation

1.2.Activities and key dates for the course

The course is taught in the second semester.

The first day of the course, the teacher will provide to the students all the relevant information:

- Methodology
- Teaching sessions
- Practical sesions
- Individual work
- Final exam
- Deadlines

2.Initiation

2.1.Learning outcomes that define the subject

In order to pass the course, the student must demonstrate the following results...

- He is able to select apropiate sensors and devices in order to perform electrical measurements and tests
- He is able to describe the power quality phenomena, its basic parameters and the current standards
- He has the capability of analyzing power quality measurements and deciding if a given installation fulfill the standards requirements
- He has the capability of provide possible solutions to real power quality problems
- He is able to planify power quality measurements selecting appropiate instrumentation and their situation based on the description of the installation

- He knows the national and internation Grid Codes, specifically the spanish operation procedures (PO 12.3 and PO 12.2)

2.2.Introduction

Renewable Energies have experienced a high increase in use over the last years. The electrical network paradigm is changing from big centralized generators to a new structure where the power generation is left to small distributed plants, mainly based in renewable sources. The connection of these generators entails big challenges and technical efects that have to be solved. Between them, the most important are the power quality and the grid estabilitiy. Voltage fluctuations, harmonics, unbalances, reactive power, etc., are phenomena increasingly frequent in the electrical network. Regarding grid estability, renewable generation plants are required to fulfill grid codes in order to be allowed their connection to the grid.

In this course the power quality phenomena will be studied. Fundamental concepts of each of them will be detailed together with their causes, effects and their possible mitigation techniques. The standards for each of phenomenon will be presented covering compatibility levels and limits. Finally the requirements needed for the grid connection of renewable sources will be studied covering national and international grid codes.

3.Context and competences

3.1.Goals

- To be able to select apropiate sensors and devices in order to perform electrical measurements and tests
- To be able to describe the power quality phenomena, its basic parameters and the current standards
- To analyze power quality measurements and deciding if a given installation fulfill the standards requirements
- To provide possible solutions to real power quality problems
- To planify power quality measurements selecting appropiate instrumentation and their situation based on the description of the installation
- To know the national and internation Grid Codes, specifically the spanish operation procedures (PO 12.3 and PO 12.2)

3.2.Context and meaning of the subject in the degree

The electrical sector is experiencing a transformation caused by the problems of the current centralized system and the growing of new technologies linked to distributed renewable generation, the storage systems, power electronics and new communication technologies.

In previous courses, students have studied several renewable energies sources, traditional electrical network characteristics and basic power electronic converters. In this course, the power quality problems originated mainly due to power electronics and the requirements for the connection to the grid of renewable sources will be studied.

The course is mainly technical and no other courses of the master are needed as pre-requisite.

3.3.Competences

3.4.Importance of learning outcomes

4.Evaluation

5.Activities and resources

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5.1.General methodological presentation
The learning process designed for this course is as follows:

The course will have both, theory lectures and practical sessions.

Lectures will be based in the master class methodolgy where the basic concepts of the course will be presented. Short practical exercises will be covered with the teacher supervission.

Practical sessions will be used for applying the knowledge acquired in the theory classes. These sessions could also be used for problem or case solving or even for lab sessions.

Students individual work could be of several types:

- Introductory research works where the students should analyse information regarding a subject asigned by the teacher and present their own conclussiones
- Works consisting on the broadening of some of the course subjects that could not be covered with enough detail in regular classes
- Practical case solving where the student acquiered capabilities are showed

5.2.Learning activities
During the course, the next learning activities will be done:
- Master class lectures where the basic concepts of the course will be presented
- Practical sessions where problems and cases will be solved
- Laboratory and simulation sessions
- Individual works
- Course final exam

5.3.Program

The course program include the next contents:tes contenidos:

1. Introduction, classification and types of sensors
2. Measurement transformers
3. Current measurement
4. Power quality introduction
5. Frequency variations
6. Voltage dips and short interruptions
7. Voltage fluctuations and flicker
8. Harmonics
9. Harmonic analysis
10. Power quality monitorization
11. Grid integration of renewable sources

Anexes

- Per unit system
- Sequence networks

5.4.Planning and scheduling
Schedule of in-class sessions and work presentations

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The course schedule can be viewed in the course webpage http://moodle2.unizar.es

The first day of the course the students will be informed about specific details, organization and schedule

5.5.Bibliography and recomended resources