Course guide
340654 - CMIX - Microgrid Control

Unit in charge: Vilanova i la Geltrú School of Engineering
Teaching unit: 710 - EEL - Department of Electronic Engineering.
Degree: MASTER'S DEGREE IN AUTOMATIC SYSTEMS AND INDUSTRIAL ELECTRONICS (Syllabus 2012). (Optional subject).
Academic year: 2023  ECTS Credits: 5.0  Languages: Spanish

LECTURER

Coordinating lecturer: Castilla Fernandez, Miguel
Others: Castilla Fernandez, Miguel

PRIOR SKILLS

It is recommended that the student have experience using MATLAB and its Simulink and SimPowerSystem tools.

REQUIREMENTS

It is recommended that the student have completed the subjects "Advanced electronic systems and integration of electrical energy sources" and "Energy management".

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CG04. CG04- Ability to research, design, develop and implement simulation methods for the control of electronic systems, automatic and robotic
CC01. CC01 - Ability to research, design, develop and characterize advanced control systems that enable the dynamic system behave according to the operational performance requirements.
CEV06. CEV06 - Ability to analyze and design power electronic converters used in power generation systems distributor energy.
CEV07. CEV07 - Ability to analyze and design power electronic converters used in micro grids and in smart power networks.

Transversal:
CT3. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

TEACHING METHODOLOGY

Theory classes consist of the presentation of concepts, examples and application exercises using basically digital media.
In laboratory classes, students work in groups solving simulation exercises related to the concepts presented in theory classes.

LEARNING OBJECTIVES OF THE SUBJECT

The objective of the course is that students be able to design control schemes for electrical microgrids. They must have learned to solve control problems in microgrids that usually operate connected to the electrical network as well as in isolated microgrids without network connection. They must know and use MATLAB, Simulink and SimPowerSystems to analyze the operation of microgrids and evaluate their performance under normal operating conditions. They must use these simulation tools to verify the operation of microgrids in situations of failure in the electrical network or in the load of the system.
STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
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</thead>
<tbody>
<tr>
<td>Hours small group</td>
<td>15,0</td>
<td>12.00</td>
</tr>
<tr>
<td>Self study</td>
<td>80,0</td>
<td>64.00</td>
</tr>
<tr>
<td>Hours large group</td>
<td>30,0</td>
<td>24.00</td>
</tr>
</tbody>
</table>

Total learning time: 125 h

CONTENTS

**Microgrids connected to the electrical network**

**Description:**
Description of the architecture, principle of operation and basic control of microgrids connected to the electrical network. Power, control and communication systems. Type of performance of power converters connected to primary sources and energy storage devices.

**Full-or-part-time:** 10h
- Theory classes: 4h
- Self study: 6h

**Islanded microgrids**

**Description:**
Description of the architecture, principle of operation and basic control of islanded microgrids without connection to the electrical network. Power, control and communication systems. Type of performance of power converters connected to primary sources and energy storage devices.

**Full-or-part-time:** 10h
- Theory classes: 4h
- Self study: 6h

**Synchronization algorithms with the grid voltage**

**Description:**
Need to synchronize the operation of the converter with the electrical network. Presentation of techniques that perform synchronization through phase or frequency tracking. Extraction of characteristics of the grid voltage, such as symmetrical components, harmonic components, ...

**Full-or-part-time:** 20h
- Theory classes: 4h
- Practical classes: 4h
- Self study: 12h
Control of microgrids connected to unbalanced networks

Description:
Problems associated with the use of conventional controls in situations of voltage imbalance. Advanced control techniques specifically designed to improve microgrid performance during voltage unbalance: increase in positive-sequence voltage, reduction in negative-sequence voltage, limitation of the current of the installation in real time.

Full-or-part-time: 45h
Theory classes: 12h
Practical classes: 6h
Self study: 27h

Control of islanded microgrids during short circuits

Description:
Problems associated with the use of conventional controls during short circuits in the loads of islanded microgrids. Advanced control techniques specifically designed to improve microgrid performance in these failure situations: variable virtual impedance, variable nominal voltage.

Full-or-part-time: 40h
Theory classes: 10h
Practical classes: 6h
Self study: 24h

GRADING SYSTEM

In laboratory classes, students work on a specific project on the control of a particular microgrid for each group. The technical benefits that the microgrid can offer both under normal operating conditions (NOOP) and in situations of failures in the electrical system (FAOP) are evaluated. Students make a presentation of their participation in the project and answer the questions asked (PRES). The grade for the course (GRADE) is calculated by applying the following formula:
GRADE = 0.3 NOOP + 0.4 FAOP + 0.3 PRES

BIBLIOGRAPHY

Basic:

RESOURCES

Computer material:
- MATLAB, Simulink, SimPowerSystems. Resource