Course guide
240256 - 240EN11 - Analysis and Control of Modern Power Electronics Dominated Power Systems

Unit in charge: Barcelona School of Industrial Engineering
Teaching unit: 709 - DEE - Department of Electrical Engineering.
Degree: MASTER'S DEGREE IN ELECTRIC POWER SYSTEMS AND DRIVES (Syllabus 2021). (Optional subject).
Academic year: 2022  ECTS Credits: 5.0  Languages: English

LECTURER

Coordinating lecturer: Gomis Bellmunt, Oriol
Prieto Araujo, Eduardo

Others:

PRIOR SKILLS

Electrical engineering, basic power electronics, basic control, basic matlab.

REQUIREMENTS

Electrical circuits analysis.

TEACHING METHODOLOGY

The methodology of the course will be based on:
- Theoretical classes
- Problem development
- Modeling and simulation (Matlab Simulink)

LEARNING OBJECTIVES OF THE SUBJECT

- Learn the fundamentals of analysis of modern renewable energy dominated systems
- Understand the basic dynamics of the power system
- Understand the basic dynamics of power converters
- Learn different techniques to assess the dynamics of modern power systems
- Learn how to simulate modern power systems
- Learn potential interaction issues in modern power systems and how to assess them
- Study innovative control techniques applied in modern power systems
- Identify potential solutions to enable 100% renewable energy networks

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guided activities</td>
<td>15,0</td>
<td>11.54</td>
</tr>
<tr>
<td>Self study</td>
<td>85,0</td>
<td>65.38</td>
</tr>
<tr>
<td>Hours small group</td>
<td>30,0</td>
<td>23.08</td>
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</tbody>
</table>
Total learning time: 130 h

CONTENTS

Modern renewable energy-based power systems

Description:
Introduction to the topic covering the following aspects:
- Course introduction
- Future renewable energy dominated power networks
- Future power electronics dominated networks
- Main system elements
- Fundamental differences between modern and classic systems
- Key technology differences
- Key challenges of modern power systems

Full-or-part-time: 7h
Laboratory classes: 2h
Self study: 5h

VSC converter technology review

Description:
This module covers the fundamentals of VSC technology (including video material)
- VSC technology
- Applications
- Main converter parts
- Operation (without control)
- Control of a conventional 2L-VSC converter
- Fundamental control blocks of a VSC
- VSC control design
- Typical controllers

Specific objectives:
- Understand/Review the fundamentals of VSC converters
- Understand the role of VSCs in modern power systems

Full-or-part-time: 12h
Laboratory classes: 2h
Self study: 10h

Conventional power system dynamics

Description:
This module will cover the following concepts:
- Fundamental elements of conventional power system
- Fundamental dynamics of the different elements
- Simulations of simple networks

Specific objectives:
- Understand the fundamental dynamics of conventional systems

Full-or-part-time: 12h
Laboratory classes: 2h
Self study: 10h
Modern power system dynamics

**Description:**
- Study the fundamental dynamics of modern power systems elements
- Simulation of simplified modern power systems

**Specific objectives:**
Understand the fundamental dynamics of modern power systems elements

**Full-or-part-time:** 24h
Laboratory classes: 4h
Self study: 20h

Phasor-based simulation of modern power systems

**Description:**
- Phasor simulation fundamentals
- Process of construction of a phasor-based model of a renewable energy based power system
- Main system dynamics and contingencies

**Specific objectives:**
- Understand the fundamentals of phasor based simulations in modern power systems

**Full-or-part-time:** 12h
Theory classes: 10h
Laboratory classes: 2h

EMT-based simulations of modern power systems

**Description:**
- EMT simulation fundamentals
- Process of construction of an EMT-based model of a renewable energy based power system
- Main system dynamics and contingencies

**Specific objectives:**
- Understand the fundamentals of EMT-based simulations in modern power systems

**Full-or-part-time:** 12h
Theory classes: 10h
Laboratory classes: 2h

Trends in analysis and control of modern power systems

**Description:**
content english

**Specific objectives:**

**Full-or-part-time:** 7h
Laboratory classes: 2h
Self study: 5h
Tools to assess dynamics and interactions in modern power systems

**Description:**
- Development of linear models of power systems assets
- Development of linear models of complete power systems
- Analysis of linear models: key techniques
- Analysis of a simple system

**Specific objectives:**
- Understand how to analyze the dynamics of a simple system

**Full-or-part-time:** 7h
Laboratory classes: 2h
Self study: 5h

**GRADING SYSTEM**

Exam: Test (50%) + Problems (50%)
Grade: Assignment 1 (25%) + Assignment 2 (25%) + Exam (50%)

**EXAMINATION RULES.**

Exam without material, only calculator is allowed.

**BIBLIOGRAPHY**

**Basic:**