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

Last modified: 13/03/2025

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: 2025 **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

Type	Hours	Percentage
Hours large group	45,0	100.00

Total learning time: 45 h

CONTENTS

Modern renewable energy-based power systems

Description:
Introduction to the topic convering 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 a 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:
Updates on relevant research trends and review of analysis and control of modern power systems

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 dynamcis 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:
- Kundur, P. S.; Malik, O. P. Power system stability and control. 2nd ed. New York: McGraw-Hill, 2022. ISBN 9781260473544.
- Anderson, P. M; Fouad, A. A. Power system control and stability. 2nd ed. New York: IEEE Press, cop. 2003. ISBN 0471238627.