Course guide
240IEL11 - 240IEL11 - Methods and Analysis Techniques for Electrical Engineering

Last modified: 10/06/2024

Unit in charge: Barcelona School of Industrial Engineering
Teaching unit: 709 - DEE - Department of Electrical Engineering.

Degree: MASTER'S DEGREE IN INDUSTRIAL ENGINEERING (Syllabus 2014). (Optional subject).

Academic year: 2024 **ECTS Credits:** 4.5 **Languages:** English

LECTURER

Coordinating lecturer: Oriol Gomis Bellmunt

Others:

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CEEELEC1. Model, analyse, calculate and design power electronic systems..

TEACHING METHODOLOGY

- Theoretical classes
- Problem solving
- Practical classes (lab and simulation)
- Non-presential assignments

LEARNING OBJECTIVES OF THE SUBJECT

The objective is to advance on the knowledge of analysis of electric power systems, also considering the transformation of the power system including renewable energy sources and power electronics. The objective is to cover both the traditional power system analysis also introducing the main challenges of modern power systems.
Specific objectives:
- To understand the challenges in modern power systems and analyze some relevant cases representing realistic applications (renewables, electrical mobility, etc.).
- To understand the nature of nonlinear electrical loads and the frequency-based analysis to analyze them. To understand the principles of filtering in power systems to improve power quality in polluted networks.
- To analyze unbalanced power systems in normal and fault conditions using the symmetrical components approach.
- To analyze transformers and power converters in modern power systems.

STUDY LOAD

Type	Hours	Percentage
Hours large group	27,0	24.00
Self study	72,0	64.00
Hours small group	13,5	12.00

Total learning time: 112.5 h

CONTENTS

Electrical calculations in modern power systems

Description:
Introduction to the modern power system. Renewable generation. Electrical mobility. Smart grids. Energy storage systems. Reduced inertia. Limited short-circuit current. Challenges in design, operation and protection of modern power systems.

Related activities:
Assignment 1 – Modern power system applications
Options: Microgrids, islands, large systems, wind turbine, solar PV inverter, energy storage unit, electrical vehicle chargers, …
- 1 Analyze the technology and the existing equipment
- 2 Define an example application
- 3 Conduct steady-state calculation (and optionally dynamic simulations) to size all the equipment and analyze the overall performance

Related competencies :
CEEELEC1. Model, analyse, calculate and design power electronic systems..

Full-or-part-time: 28h 30m
Theory classes: 7h
Laboratory classes: 3h 30m
Self study : 18h

Harmonics and filters

Description:
Non-sinusoidal periodic functions. Fourier analysis. Power definitions. Three phase systems. Circuit analysis in presence of harmonics. Filter design. Passive and active filters. Frequency analysis. Calculations of systems with harmonics and filter design. Lab testing. Simulation analysis.

Related activities:
Assignment 2 – Harmonics and filtering
- 1 practical class in the lab for gathering measurements of non-linear loads
- 2 Development of a simulation model
- 3 Analysis and matching of results between model and experimental measurements
- 4 Filter design and validation

Related competencies :
CEEELEC1. Model, analyse, calculate and design power electronic systems..

Full-or-part-time: 28h
Theory classes: 6h 40m
Laboratory classes: 3h 20m
Self study : 18h

Symmetrical components

Description:
Balanced and unbalanced systems. Fortescue transformation. Circuit analysis. Fault analysis of several types of faults. Simulation analysis.

Related competencies :
CEEELEC1. Model, analyse, calculate and design power electronic systems..

Full-or-part-time: 28h
Theory classes: 6h 40m
Laboratory classes: 3h 20m
Self study : 18h

Transformers and converters

Description:
Three phase transformers. Connection groups for transformers. Power converter principles. Simplified analysis of converters for exchange of active and reactive power. Analysis of grids with converters and transformers. Simulation analysis.

Related competencies :
CEEELEC1. Model, analyse, calculate and design power electronic systems..

Full-or-part-time: 28h
Theory classes: 6h 40m
Laboratory classes: 3h 20m
Self study : 18h

GRADING SYSTEM

60 % Final exam
40 % Assignments

BIBLIOGRAPHY

Basic:
- Grainger, John J.; Stevenson, William D. Análisis de sistemas de potencia. México: McGraw-Hill, 1996. ISBN 9701009088.