

Course guide 240IEL21 - 240IEL21 - Electrical Systems

Last modified: 15/06/2023

Academic year: 2023	ECTS Credits: 4.5	Languages: Spanish	
Degree:	MASTER'S DEGREE IN INDUSTRIAL ENGINEERING (Syllabus 2014). (Optional subject).		
Unit in charge: Teaching unit:	Barcelona School of Industrial Engineering 709 - DEE - Department of Electrical Engineering.		

LECTURER

Coordinating lecturer:	Sumper, Andreas
Others:	Sumper, Andreas

PRIOR SKILLS

Electrical engineering, Circuit Theory, Electrical Machines

REQUIREMENTS

Electrical engineering, Circuit Theory, Electrical Machines

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

CEMEI01. Knowledge and ability to analyse and design the generation, transport and distribution systems in electric energy. CEEELEC1. Model, analyse, calculate and design power electronic systems.

TEACHING METHODOLOGY

Course methodology:

- Theoretical classes/problems: In the classes we will address the fundamental concepts and solve related problems.
- Directed work: Students carry out individual work to apply the knowledge acquired and develop practical skills.

LEARNING OBJECTIVES OF THE SUBJECT

This course provides knowledge of the key components and functions of electric power transmission and distribution systems. The following topics are covered:

- 1. Components and functions of the electric power transmission and distribution system.
- 2. Analysis of overhead lines, including electrical parameters, equivalent circuits and calculations using the per unit (p.u.) system.
- 3. Study of transformers, types, connections and equivalent circuits.
- 4. Load flow in power systems, with focus on the bus admittance matrix, problem statement and resolution algorithms.
- 5. Mechanical calculations of overhead lines, considering types of supports, calculation of deflections, stresses in the cable, influence of temperature and other atmospheric conditions, calculation of change of state and RLAT.
- 6. Use of commercial or open source calculation and simulation tools for the analysis of power systems.

With this approach, students will acquire a solid understanding of the fundamental components and processes in electrical power systems, as well as the ability to use modern analysis tools.



STUDY LOAD

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

Total learning time: 112.5 h

CONTENTS

Introduction

Description:

The module focuses on the detailed study of the components, structure and functions of the electricity transmission and distribution system.

Related competencies :

CEMEI01. Knowledge and ability to analyse and design the generation, transport and distribution systems in electric energy.

Full-or-part-time: 9h Theory classes: 3h Self study : 6h

Parameters and Overhead Line Modelling

Description:

This module focuses on the comprehensive study of overhead line parameters, including the equivalent single-phase circuit equations and providing a detailed analysis of these parameters.

Related competencies :

CEMEI01. Knowledge and ability to analyse and design the generation, transport and distribution systems in electric energy. CEEELEC1. Model, analyse, calculate and design power electronic systems..

Full-or-part-time: 17h 30m

Theory classes: 4h 30m Practical classes: 3h Self study : 10h



Steady state analysis of overhead lines

Description:

In this module, matrix equations for the modelling of overhead lines with distributed parameters, considering long, medium and short length lines will be addressed. Electrical parameters, equivalent circuits of long, medium and short length lines and related calculations such as voltage drop, power transmission, voltage regulation and reactive compensation will be discussed in depth. Steady state analysis on a per unit basis.

Related competencies :

CEMEI01. Knowledge and ability to analyse and design the generation, transport and distribution systems in electric energy. CEEELEC1. Model, analyse, calculate and design power electronic systems.

Full-or-part-time: 21h Theory classes: 6h Practical classes: 3h Self study : 12h

Transformers

Description:

In this module, the different types of transformers, their connections and equivalent circuits will be explored, as well as their representation in the unit system and the study of three-winding transformers.

Related competencies :

CEMEI01. Knowledge and ability to analyse and design the generation, transport and distribution systems in electric energy. CEEELEC1. Model, analyse, calculate and design power electronic systems..

Full-or-part-time: 18h

Theory classes: 3h Practical classes: 3h Self study : 12h

Load flow in power systems

Description:

In this module, the admittance matrix of an electrical system will be defined, addressing the approach to the problem and the corresponding resolution algorithms. In addition, the interpretation of the results will be offered and specialised programs used in this field will be explored.

Related competencies :

CEMEI01. Knowledge and ability to analyse and design the generation, transport and distribution systems in electric energy. CEEELEC1. Model, analyse, calculate and design power electronic systems.

Full-or-part-time: 19h 30m

Theory classes: 6h Practical classes: 1h 30m Guided activities: 12h



Mechanical calculation of overhead lines

Description:

This module focuses on the different types of supports used in overhead lines, as well as the calculation of sag and stresses in the cable. The influence of temperature and other atmospheric conditions will also be discussed, together with the calculation of change of state and consideration of the Spanish Reglementation RLAT.

Related competencies :

CEMEI01. Knowledge and ability to analyse and design the generation, transport and distribution systems in electric energy. CEEELEC1. Model, analyse, calculate and design power electronic systems.

Full-or-part-time: 13h Theory classes: 1h 30m Practical classes: 1h 30m Self study : 10h

Advanced aspects of the electric power system

Description:

This module addresses advanced aspects of the electrical power system, such as transients on overhead lines, short-circuit calculation, stability analysis and economic dispatch, providing an in-depth and comprehensive approach to these advanced topics in electrical engineering.

Related competencies :

CEMEI01. Knowledge and ability to analyse and design the generation, transport and distribution systems in electric energy. CEEELEC1. Model, analyse, calculate and design power electronic systems..

Full-or-part-time: 14h 30m Theory classes: 3h Practical classes: 1h 30m Self study : 10h

GRADING SYSTEM

Grade = max{N1;N2;N3} N1 = 0,3·NEp + 0,5·NEf + NTr·0,2 N2 = NEf·0,8 + NTr·0,2 N3 = NEr·0,8 + NTr·0,2 NEp: Midterm Examination mark (problems) NEf: Final Examination mark (problems + theory) NTr: Work mark NEr: Re-evaluation Examination mark (problems + theory)

EXAMINATION RULES.

The mid-term exam will take place during the teaching timetable (1.5 hours). It consists of numerical exercises with the contents taught up to the time of the exam. A free-form A4 sheet of paper can be handed in at the end of the exam. It is necessary to bring a scientific calculator capable of performing calculations with complex numbers (e.g. hyperbolic functions of complex numbers).

The Final Examination will take place in the timetable assigned by the School (2,5h). It consists of numerical exercises with all the contents taught. A free-form A4 sheet of paper may be taken. It is necessary to bring a scientific calculator capable of performing calculations with complex numbers (e.g. hyperbolic functions of complex numbers).

The Re-evaluation Examination will take place within the timetable assigned by the School (2,5h). It consists of numerical exercises with all the contents taught. A free-form A4 sheet of paper may be brought along. It is necessary to bring a scientific calculator capable of performing calculations with complex numbers (e.g. hyperbolic functions of complex numbers).

The assignment must be handed in via the Atenea digital campus, in pdf format, following the instructions contained in the corresponding statements, accessible from Atenea.



BIBLIOGRAPHY

Basic:

- Thue, William A. Electrical power cable engineering. 3rd ed.. Boca Raton: CRC Press, 2012. ISBN 9781439856437.

- Ramírez Rosado, Ignacio J. Problemas resueltos de sistemas de energía eléctrica. Madrid: Thomson, cop. 2007. ISBN 9788497324083.

- Gómez Expósito, Antonio; Conejo, Antonio J; Cañizares, Claudio. Electric energy systems : analysis and operation [on line]. Boca Raton: CRC Press, cop. 2009 [Consultation: 24/01/2017]. Available on: http://site.ebrary.com.recursos.biblioteca.upc.edu/lib/upcatalunya/detail.action?docID=10240643. ISBN 9780849373657.

- Tleis, Nasser D. Power systems modelling and fault analysis [Recurs electrònic] Theory and Practice [on line]. Amsterdam ; London: Elsevier Newnes, 2008 [Consultation: 17/11/2022]. Available on: https://www-sciencedirect-com.recursos.biblioteca.upc.edu/book/9780750680745/power-systems-modelling-and-fault-analysis. ISBN 9780750680745.

RESOURCES

Other resources:

Matpower: https://www.pserc.cornell.edu/matpower/