UNIVERSIDAD DE CASTILLA - LA MANCHA

GUÍA DOCENTE

1. General information

Course: POWER SYSTEMS
Code: 310620
Type: CORE COURSE
ECTS credits: 6
Degree: 2338 - MASTERS DEGREE PROGRAMME IN INDUSTRIAL ENGINEERING (AB)
Academic year: 2020-21
Center: 605 - SCHOOL OF INDUSTRIAL ENGINEERS. AB
Group(s): 10 11
Year: 1
Duration: C2
Main language: English
Second language: English
Use of additional languages:
English Friendly: N
Web site:
Bilingual: N

Lecturer: **EMILIO GOMEZ LAZARO** - Group(s): **10 11**

Building/Office	Department	Phone number	Email	Office hours
Infante Don Juan Manuel / 0.C9	INGENIERÍA ELÉCTRICA, ELECTRÓNICA, AUTOMÁTICA Y COMUNICACIONES		emilio.gomez@uclm.es	

Lecturer: **ANDRES HONRUBIA ESCRIBANO** - Group(s): **10 11**

Building/Office	Department	Phone number	Email	Office hours
INFANTE D. JUAN MANUEL/0.C.6	INGENIERÍA ELÉCTRICA, ELECTRÓNICA, AUTOMÁTICA Y COMUNICACIONES		andres.honrubia@uclm.es	

2. Pre-Requisites

It is recommended that the student has specific knowledge about circuits theory, electrical machines, electrical installations, control, electronics and power electronics.

3. Justification in the curriculum, relation to other subjects and to the profession

At the Order CIN/311/2009, 9th of February, the requirements for the verification of the official University degrees that set up the practice of the Industrial Engineer are stablished. It that Order, the minimum amount of credits are stablished equal to 30 European credits for the Industrial Technologies module and 15 for the Installations, facilities and complementary buildings. Among them, it is stablished to have proper knowledge about specific and technologic issues related to electrical engineering and energy engineering, infrastructures, etc. Electric Energy Systems subject is completely covering the competences included in that Order, such as knowledge and ability for the analysis and design of generation systems, transmission and distribution of electric energy, knowledge and abilities that allow the understanding, analysis, operation and management of different energy sources and partially covering others such as knowledge and abilities to design electrical installations and fluids, lighting, air conditioning systems, energy efficiency acoustics, communication networks, home automation, smart buildings and security installations.

Electric Energy Systems subject is providing the basic knowledge about the operation and control of the electric power systems as well as the basic concepts to design an electrical installation

4. Degree competences achieved in this course

Course competences

Code	Description
A01	To have appropriate knowledge of the scientific and technological aspects of mathematical, analytical and numerical methods in engineering, electrical engineering, energy engineering, chemical engineering, mechanical engineering, continuous medium mechanics industrial electronics, automation, manufacturing, materials, quantitative management methods, industrial computing, town planning, infrastructures, etc.
A02	To plan, calculate and design products, processes, facilities and plants.
A04	To conduct research, development and innovation in products, processes and methods.
B01	Knowledge and capacity for the analysis and design of systems for generating, transporting and generating electricity.
B06	Knowledge and capacity to understand, analyse, exploit and manage different energy sources.
CB06	Knowledge and skills to organise and manage enterprises.
CB07	Strategy and planning knowledge and skills applied to different organisational structures.
CB09	Knowledge of financial and costs accounting.
CB10	Knowledge of information systems for management, industrial organisation, production, logistics and quality management systems.
D04	Knowledge and abilities to plan and design electrical and fluid installations, lighting, heating and ventilation, energy saving and efficiency, acoustics, communications, domotics, Smart buildings and security installations.

5. Objectives or Learning Outcomes

Course learning outcomes

Description

Acquire basic knowledge for designing an electrical installation: sizing, transformer centres, protection, conductors, etc.

Acquire basic knowledge for understanding and analysing the problem of tension and frequency control.

Acquire basic knowledge for modelling and determining optimal charge flows.

Understand the importance of studying the safety of electrical energy systems.
Understand the importance of state estimation in the operational safety of a system.

6. Units / Contents

Unit 1: Introduction to Electric Energy Sistems
Unit 2: Load flow, optimal load flow
Unit 3: Fequency and voltage control
Unit 4: Operation of the generation system
Unit 5: Shortcircuit analysis and protection systems
Unit 6: Power system state estimation
Unit 7: Electrical installations

ADDITIONAL COMMENTS, REMARKS

The following Lab Practice are expected to be conducted:

- Practice 1: Load flow

- Practice 2: shortcircuits and protections

7. Activities, Units/Modules and Methodology

Training Activity	Methodology	Related Competences (only degrees before RD 822/2021)	ECTS	Hours	As	Com	Description
Class Attendance (theory) [ON-SITE]	Lectures	A01 A02 A04 B01 B06 CB06 D04	1.08	27	Y	N	
Class Attendance (practical) [ON-SITE]	Practical or hands-on activities	A01 A02 A04 B01 B06 CB06 D04	0.96	24	Y	N	
Writing of reports or projects [OFF-SITE]	Practical or hands-on activities	A01 A02 A04 B06 CB06 CB07 CB09 CB10 D04	1.8	45	Y	N	
Project or Topic Presentations [ON-SITE]	Assessment tests	A01 A02 A04 B01 B06 CB06 CB07 CB09 CB10 D04	0.24	6	Y	N	
Progress test [ON-SITE]	Assessment tests	A01 A02 A04 B01 B06 CB06 CB07 CB09 CB10 D04	0.12	3	Y	Y	
Study and Exam Preparation [OFF-SITE]	Self-study	A01 A02 A04 B01 B06 CB06 CB07 CB09 CB10 D04	1.8	45	Y	N	
		Total:	**6**	**150**			
		Total credits of in-class work: 2.4					**Total class time hours: 60**
		Total credits of out of class work: 3.6					**Total hours of out of class work: 90**

As: Assessable training activity
Com: Training activity of compulsory overcoming (It will be essential to overcome both continuous and non-continuous assessment).

8. Evaluation criteria and Grading System

Evaluation System	Continuous assessment	Non-continuous evaluation*	Description
Practicum and practical activities reports assessment	5.00%	0.00%	Evaluation of the reports made by the student related to the Practice Lab
Progress Tests	35.00%	40.00%	Evaluation of the Practice topics
Final test	60.00%	60.00%	A minimum mark of 4.5 out of 10 is required
Total:	**100.00%**	**100.00%**	

According to art. 4 of the UCLM Student Evaluation Regulations, it must be provided to students who cannot regularly attend face-to-face training activities the passing of the subject, having the right (art. 12.2) to be globally graded, in 2 annual calls per subject , an ordinary and an extraordinary one (evaluating 100% of the competences).

Evaluation criteria for the final exam:

Continuous assessment:

Assessment of the theory and practice knowledge. The exam associated with the theory concepts may include one section with questions and another with problems, being necessary to obtain a minimum mark of 4.5 out of 10 in each section to pass this theory exam.
The average mark of the laboratory reports will represent 5% of the final mark obtained. The mark obtained at the theory exam will represent 65% of the final mark, and the evaluation of the practice knowledge will represent the last 30% (in case this knowledge has not been previously passed through the continuous evaluation).
In any case, in order to pass this subject, a minimum mark of 4.5 out of 10 is required in both theory and practice knowledge.

Non-continuous evaluation:

Both parts, theory and practice, are evaluated.

Specifications for the resit/retake exam:

The evaluation criteria in the extraordinary examination session are the same as in the ordinary examination session. Those students who have failed any part of the subject (theory or practice) will be evaluated of both parts, representing the practice exam the 35% of the final mark in this case.

Specifications for the second resit / retake exam:

In this special call, the marks obtained in previous years are not used for the present.

9. Assignments, course calendar and important dates

Not related to the syllabus/contents

Hours	hours
Project or Topic Presentations [PRESENCIAL][Assessment tests]	6
Progress test [PRESENCIAL][Assessment tests]	3
Study and Exam Preparation [AUTÓNOMA][Self-study]	45

Unit 1 (de 7): Introduction to Electric Energy Sistems

Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	3
Writing of reports or projects [AUTÓNOMA][Practical or hands-on activities]	4

Unit 2 (de 7): Load flow, optimal load flow

Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	4
Class Attendance (practical) [PRESENCIAL][Practical or hands-on activities]	8
Writing of reports or projects [AUTÓNOMA][Practical or hands-on activities]	10

Unit 3 (de 7): Fequency and voltage control

Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	4
Class Attendance (practical) [PRESENCIAL][Practical or hands-on activities]	6
Writing of reports or projects [AUTÓNOMA][Practical or hands-on activities]	11

Unit 4 (de 7): Operation of the generation system

Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	4
Writing of reports or projects [AUTÓNOMA][Practical or hands-on activities]	6

Unit 5 (de 7): Shortcircuit analysis and protection systems

Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	4
Class Attendance (practical) [PRESENCIAL][Practical or hands-on activities]	6
Writing of reports or projects [AUTÓNOMA][Practical or hands-on activities]	6

Unit 6 (de 7): Power system state estimation

Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	4
Class Attendance (practical) [PRESENCIAL][Practical or hands-on activities]	4
Writing of reports or projects [AUTÓNOMA][Practical or hands-on activities]	4

Unit 7 (de 7): Electrical installations

Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	4
Writing of reports or projects [AUTÓNOMA][Practical or hands-on activities]	4

Global activity

Activities	hours
Class Attendance (practical) [PRESENCIAL][Practical or hands-on activities]	24
Writing of reports or projects [AUTÓNOMA][Practical or hands-on activities]	45
Class Attendance (theory) [PRESENCIAL][Lectures]	27
Project or Topic Presentations [PRESENCIAL][Assessment tests]	6
Progress test [PRESENCIAL][Assessment tests]	3
Study and Exam Preparation [AUTÓNOMA][Self-study]	45
Total horas:	150

10. Bibliography and Sources

Author(s)	Title/Link	Publishing house	City	ISBN	Year	Description
E. Muljadi and E. Gómez-Lázaro and A. Ginart	Power Electronic Converters and Systems: Frontiers and Applications http://dx.doi.org/10.1049/PBPO074E	The Institution of Engineering and Technology		978-1-84919-826-4	2015	
E. Muljadi and E. Gómez-Lázaro and A. Ginart	Power Electronic Converters and Systems: Frontiers and Applications http://dx.doi.org/10.1049/PBPO074E	The Institution of Engineering and Technology		978-1-84919-826-4	2015	
A. Orths, H. Abildgaard, F. van Hulle, J. Kiviluoma, B. Lange, M. O¿Malley, D. Flynn, A. Keane, J. Dillon, E. M. Carlini, J. O. Tande, A. Estanqueiro, E. Gómez-Lázaro, L. Söder, M. Milligan, J. C. Smith, y C. Clark.	WIND INTEGRATION STUDIES http://www.ieawind.org/task_25.html		Finland		2013	
Andrzej M. Trzynadlowski (Editor), Eduard Muljadi, Emilio Gomez-Lazaro, Antonio Ginart	Power Electronic Converters and Systems: Frontiers and Applications	The Institution of Engineering and Technology		978-1849198264	2015	

Antonio Gomez-Expósito, Claudio Cañizares, Antonio J. Conejo	https://iet.presswarehouse.com/books/BookDetail.aspx?productID=405109 Electric Energy Systems - Analysis and Operation	CRC	EEUU	9780849373657	2009	
Antonio Gómez Expósito y otros	Análisis y operación de sistemas de energía eléctrica	Mc Graw Hill Interamericana S.L		978-8448135928	2002	
Emilio Gómez Lázaro						Material desarrollado para la asignatura
H. Holttinen, J. Kiviluoma, A. Robitaille, N. A. Cutululis, A. Orths, F. Van Hulle, I. Pineda, B. Lange, M. O¿Malley, J. Dillon, E. M. Carlini, C. Vergine, J. Kondoh, Y. Yasuda, M. Gibescu, J. Olav Tande, A. Estanqueiro, E. Gómez-Lázaro, L. Söder, J. C. Smith, M. Milligan, y D. Lew.	Design and operation of power systems with large amounts of wind power http://www.ieawind.org/task_25.html	Julkaisija-Utgivare	Helsinki, Finland	978-951-38-7308-0	2013	
J. Duncan Glover, Mulukutla S. Sarma, Thomas Overbye	Power System Analysis and Design	Cengage Learning		9781111425791	2011	
J. M. Adell, J. Canales, M. Gálvez, A. Frossard, J. L. Garda, E. Gómez-Lázaro, N. Goodall, E. Méndez, J. L. Plá, A. Pototschnig, J. C. Ruiz, A. Salem, R. Schaeffer, y J. Verde	Energía: Desarrollos tecnológicos en la protección medioambiental	Thomson Reuters		978-84-470-3806-0	2011	
J. Roger Folch, M. Riera Guasp, C. Roldán Porta	Tecnología Eléctrica	Síntesis		8477387672	2000	
Jaquelin Cochran, Mackay Miller, Michael Milligan, Erik Ela, Douglas Arent, Aaron Bloom, Matthew Futch, Juha Kiviluoma, Hannele Holtinnen, Antje Orths, Emilio Gómez-Lázaro, Sergio Martín-Martínez, Steven Kukoda, Glycon Garcia, Kim Møller Mikkelsen, Zhao Yongqiang, y Kaare Sandholt.	Market Evolution: Wholesale Electricity Market Design for 21st Century Power Systems http://www.nrel.gov/docs/fy14osti/57477.pdf	21stCenturyPower.org		NREL/TP-6A20-57477	2013	
John J. Grainger, William D. Stevenson	Análisis de sistemas de potencia	MacGraw-Hill		9789701009086	1999	
S. Martin-Martínez, A. Vigueras-Rodríguez, E. Gómez-Lázaro, A. Molina-García, E. Muljadi, y M. Milligan	Advances in wind power http://www.intechopen.com/books/advances-in-wind-power	Intech	Rijeka, Croatia	978-953-51-0863-4	2012	
A. Molina-García and A.D. Hansen and E. Muljadi and V. Gevorgian and J. Fortmann and E. Gómez-Lázaro	Large Scale Grid Integration of Renewable Energy Sources http://dx.doi.org/10.1049/PBPO0980	The Institution of Engineering and Technology		978-1-78561-162-9	2017	