Teaching Guide				
Identifying Data				2024/25
Subject (*)	Electrical Technology		Code	730497201
Study programme	Mestrado Universitario en Enxeñaría Industrial (plan 2018)			
Descriptors				
Cycle	Period	Year	Type	Credits
Official Master's Degree	1st four-month period	First	Optional	4.5
Language	SpanishGalician			
Teaching method	Face-to-face			
Prerequisites				
Department	Enxeñaría Industrial			
Coordinador	Méndez Sanmartín, Cristian	E-mail	cristian.mendez@udc.es	
Lecturers	Méndez Sanmartín, Cristian	E-mail	cristian.mendez@udc.es	
Web	campusvirtual.udc.es			
General description	Nesta materia descríbense e analizan Sistemas de Enerxía Eléctrica (SEE). A materia divídese en dous partes. A primeira está dedicada á análise de circuítos eléctricos e aos fundamentos das máquinas eléctricas; nesta parte cabe destacar a descrición, modelización e análise dos transformadores e as máquinas síncronas. Nunha segunda parte introdúcense os SEE, descríbense os elementos que os compoñen, así como aspectos operativos, construtivos e analíticos destes sistemas. Calquera cambio ou evento relacionado coa docencia e avaliación da materia será anunciado polo profesor da mesma nas clases presenciais. Con todo, o profesor habilitará canles telemáticas alternativas para os alumnos que non asisten ás clases presenciais co obxecto de manterse ao corrente de calquera anuncio ou incidencia.			

Study programme competences / results	
Code	Study programme competences / results
A1	ETI1 - Knowledge and capacity for the analysis and design of electricity generation, transport and distribution systems.
A6	ETI6 - Knowledge and abilities that allow to understand, analyze, exploit and manage the different sources of energy.
B2	CB7 - That students know how to apply the knowledge acquired and their ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their area of ??study.
B5	CB10 - That students have the learning skills that allow them to continue studying in a way that will be largely self-directed or autonomous.
B6	G1 - Have adequate knowledge of the scientific and technological aspects in Industrial Engineering.
B7	G2 - Project, calculate and design products, processes, facilities and plants.
B13	G8 - Apply the knowledge acquired and solve problems in new or unfamiliar environments within broader and multidisciplinary contexts.
B16	G11 - Possess the learning skills that allow to continue studying in a self-directed or autonomous way.
C1	ABET (a) - An ability to apply knowledge of mathematics, science, and engineering.
C3	ABET (c) - An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
C5	ABET (e) - An ability to identify, formulate, and solve engineering problems.
C8	ABET (h) - The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.
C9	ABET (i) - A recognition of the need for, and an ability to engage in life-long learning.
C11	ABET (k) - An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Learning outcomes	
Learning outcomes	Study programme competences / results

The student will be able to know, identify, evaluate and dimension the different elements of an electrical energy system, which, among others, include electrical machines, electrical conduits, electrical switchgear and protections. Likewise, they will know how to analyse the behaviour of the aforementioned elements on the basis of their models and equivalent circuits.	AJ1 AJ6	BJ2 BJ5 BJ6 BJ7 BJ13 BJ16	CJ1 CJ3 CJ5 CJ8 CJ9 CJ11

Contents	
Topic	**Sub-topic**
The following blocks or subjects develop the contents established in the Verification Report file, which are:	Analysis and design of: - Electricity generation systems. - Electricity transmission and distribution systems. Exploitation and management of the different energy sources.
Introduction	Electrical Circuit Analysis Fundamentals of Electromagnetism
General Overview of Electric Power Systems	Introduction to the analysis of electrical energy systems. Elements in electrical energy systems. - Electric power transmission lines. - Power transformers - Asynchronous and synchronous machines. - Substations. Busbar configuration and operations. Modelling of electrical elements (quadripoles). - Impedance parameters. - Admittance parameters. - Hybrid and inverse hybrid parameters. - Inverse transmission and transmission parameters. - Parameter conversion - Quadrupole connection
Load Flow Analysis	Introduction to the unit system. Kennelly's Theorem Load flows. - Node classification, network state and Boucherot's theorem. - Node matrix equations for connection matrices. - Magnetic couplings - Node matrix equations by direct inspection of circuits. - Definition of node admittance matrix. - Calculation of node voltages and load flows. - Iterative resolution methods: Gauss-Seidel and Newton-Raphson.

Short-Circuit Analysis	Definition of node impedance matrix. - Direct construction of node impedance matrix. - Modification of network status. Definition of short-circuit. - Actuation of protective devices Power circuit breakers and disconnectors. - Definition of transient and sub-transient regimes. Calculation of symmetrical short circuits. - Three-phase short-circuit of a no-load synchronous machine. - Three-phase short-circuit of a no-load line. Symmetrical components (Fortescue-Stokvis theorem) - Direct component - Inverse component - Homopolar component (connection groups). Calculation of asymmetrical short circuits. - Phase-to-earth short-circuit - Phase-to-phase short-circuit - Phase-to-phase-to-earth short-circuit - Lack of open conductor

Planning				
Methodologies / tests	Competencies / Results	Teaching hours (in-person & virtual)	Student?s personal work hours	Total hours
Guest lecture / keynote speech	A1 A6 B2 C1	29	0	29
Problem solving	A1 B2 B13 C1 C5 C11	12.1	26.9	39
ICT practicals	A1 A6 B2 B13 B6 C5 C11	0	16.2	16.2
Supervised projects	A1 A6 B2 B5 B13 B16 B7 B6 C1 C3 C5 C8 C9 C11	2	20.3	22.3
Field trip	A1 A6 B2 B13 B6 C5 C11	2	0	2
Objective test	A1 A6 B2 B6 C1 C5	2	0	2
Personalized attention		2	0	2
(*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.				

Methodologies	
Methodologies	Description
Guest lecture / keynote speech	Introductory session to the subject. Explanation of content by the teacher.
Problem solving	Students solve calculation problems proposed by the teacher.
ICT practicals	Subject to availability / Not confirmed: --- Practical sessions where students are responsible for carrying out exercises using ICT tools. If it is not possible to allocate these hours to practicals, they will be reused in the lecture and problem-solving session.
Supervised projects	This is an activity that the teacher may propose individually or in groups. The work can be of different natures, depending on the needs and circumstances of each course and always with the criterion of continuous assessment. Commonly, this will include, first, the study of a topic and/or the development of a software tool for a specific topic and, then, the resolution of problems related to the proposed topic.

Field trip	Subject to availability / Not confirmed: ---------- Scientific and/or informative events or field trips. Invited lectures or classes given by experts or by collaborating companies related to the competences of each subject. Visits to industrial facilities related to the competences of each subject. If it is not possible to allocate these hours to practical work, they will be reused for lectures and problem solving.
Objective test	Answer to questions or solve exercises without means of consultation or with restricted means of consultation, in a specific limited space of time.

Personalized attention	
Methodologies	**Description**
ICT practicals Supervised projects Guest lecture / keynote speech Problem solving	The teacher responds individually or in a group to questions or queries made by students.

Assessment			
Methodologies	**Competencies / Results**	**Description**	**Qualification**
Supervised projects	A1 A6 B2 B5 B13 B16 B7 B6 C1 C3 C5 C8 C9 C11	A 30% assessment of this section will be included in the case of supervised work, if this is the case. This will be voluntary. If this were not the case, this percentage would be added to the objective test.	30
Objective test	A1 A6 B2 B6 C1 C5	In the correction of objective tests, the following factors may be taken into account, among other things: - The follow-up of the instructions for its realization. - The technical correctness of the calculations and results. - The order, cleanliness and organization of the delivered material. - The correct expression of the ideas and reasoning used.	70
Others			

Assessment comments

The evaluation of the subject will be carried out through the following tests:
Activities that can be carried out during the school period:
It may be proposed to carry out supervised work with a value of up to 30% of the total value of the subject grade (in the case of the proposed carrying out of these scores it will not be recoverable).Final objective test:
Completion of this objective test will be mandatory in order to pass the subject, 40% of the test must be presented and passed correctly in order to add up the score for the activities that can be carried out during the academic period. Depending on the organization or not of the activities during the academic period, the evaluation of the punctuation of the same would be added to the final percentage of the final objective test, which could vary between 70% and 100% of the weighting of the final grade, being necessary to exceed 50% of the test to pass the subject. The assessment method will be the same for the first and second opportunities.Note on the assessment of non-face-to-face activities:
Non-face-to-face activities:
The teacher will reserve the right to request additional information by video conference in order to validate the veracity of the authorship of the content presented, reserving the right to a reduction of up to 100% of the score obtained in the case of inconclusive answers that may present doubts about the work done .Additional conditions:
Condition of not presented:
Students who do not present themselves for the first or second opportunity objective test will obtain the status of not presented, regardless of the evaluation of the possible activities carried out during the academic period.Early call:
Students who make an early call may retain the score obtained in the activities carried out during the academic period during a call. After this, if the subject has not been passed or no test has been taken, they will be evaluated through a final objective test, scoring it at 100% of the subject's grade, and it is necessary to pass 50% of the test to pass the subject.All regulatory aspects related to ?academic dispensation?, ?dedication to study?, ?permanence? and ?academic fraud? will be governed by the current regulations of the UDC.

Sources of information	
Basic	- Kothari D. P., Nagrath I. J. (2008). Modern Power System Analysis. McGraw Hill - Grainger J. J., Stevenson W. D. (1996). Análisis de Sistemas de Potencia. McGraw Hill - Jesús Fraile Mora (2008). Máquinas Eléctricas. McGraw Hill - Fermín Barrero (2004). Sistemas de Energía Eléctrica. Thomson - Saadat H. (2011). Power System Analysis. PSA Publishing LLC - Bergen A.R., Vittal V. (1986). Power System Analysis. Prentice-Hall International - Theodore Wildi (2007). Máquinas Eléctricas y Sistemas de Potencia. Pearson
Complementary	

Recommendations
Subjects that it is recommended to have taken before
Subjects that are recommended to be taken simultaneously
Subjects that continue the syllabus
Other comments
To help achieve an immediate sustainable environment and fulfill the objective of action number 5: "Teaching and research that is healthy and environmentally and socially sustainable" of the "Green Campus Ferrol Action Plan":The delivery of the documentary work carried out in this matter:1.1. It will be requested in virtual format and/or computer support.1.2. It will be done through Moodle, in digital format without the need to print them.1.3. If done on paper:- Plastics will not be used- Double-sided printing will be carried out.- Recycled paper will be used.- The printing of drafts will be avoided.In addition to this, the full integration of students who, for physical, sensory, psychological or socio-cultural reasons, experience difficulties in having a suitable, equal and profitable access to university life will be facilitated.