



## IDENTIFYING DATA

### Electrical engineering

Subject	Electrical engineering			
Code	O07G410V01302			
Study programme	(*)Grao en Enxeñaría Aeroespacial			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	1st
Teaching language	Spanish			
Department				
Coordinator	Albo López, Ana Belén			
Lecturers	Albo López, Ana Belén			
E-mail	aalbo@uvigo.es			
Web	http://aero.uvigo.es			
General description	<p>The objectives pursued with this subject are:</p> <ul style="list-style-type: none"> <li>- Acquisition of knowledge related to symbols, magnitudes, principles, basic elements and laws of electricity.</li> <li>- Knowledge of techniques and methods of circuit analysis in sinusoidal steady-state.</li> <li>- Description of three-phase systems.</li> <li>- Knowledge of the operating principles and characteristics of the different electrical machines.</li> <li>- Basic knowledge of electrical installations and systems.</li> </ul>			

## Competencies

Code	
B1	Capability for design, development and management in the field of aeronautical engineering (in accordance with what is established in section 5 of order CIN / 308/2009), aerospace vehicles, aerospace propulsion systems, aerospace materials, airport infrastructures, air navigation infrastructures and space management, air traffic and transport management systems.
B4	Verification and certification in the field of aeronautical engineering that aim, in accordance with the knowledge acquired (in accordance with what is established in section 5 of order CIN / 308/2009), aerospace vehicles, aerospace propulsion systems, aerospace materials, airport infrastructures, air navigation infrastructures and space management, air traffic and transport management systems.
C17	Appropriate knowledge applied to engineering: Fundamental elements of the different types of aircrafts; the functional elements of air navigation systems and associated electrical and electronic installations; foundations of the design and construction of airports.
D1	Capability of analysis, organization and planification.
D3	Capability of oral and written communication in native language
D4	Capability of autonomous learning and information management
D5	Capability to solve problems and draw decisions
D6	Capability for interpersonal communication
D8	Capability for critical and self-critical reasoning
D13	Sustainability and environmental commitment. Equitable, responsible and efficient use of resources

## Learning outcomes

Expected results from this subject	Training and Learning Results		
Capacity to analyse electrical circuits and its application in the resolution of real problems	B1 B4	C17	D1 D3 D4 D5 D6 D8 D13

Basic knowledge of electrical machines and their utilization	B1 B4	C17	D1 D3 D4 D5 D6 D8 D13
Capacity to design and calculate basic electrical installations	B1 B4	C17	D1 D3 D4 D5 D6 D8 D13

## Contents

Topic	
Topic I: Introduction.	Active and passive elements of the electrical circuits.
Topic II: Alternating current circuits: single-phase and three-phases	Waveforms. Behavior of the elements in alternating current. Ideal and real elements. Combinations of elements. Kirchhoff's laws. Substitution, superposition, Thevenin and Norton Theorems. Complex, apparent, active and reactive powers. Boucherot Theorem. Balanced three-phase system: values of line and phase, reduction to the equivalent single-phase circuit.
Topic III: Basics of Electrical Machines	Single-phase and three-phase transformers: constitution, in no-load operation and in load, equivalent circuit and time index. Asynchronous machines: constitution, generation of the rotating field, in no-load operation and in load, equivalent circuit, characteristic curves, maneuvers. Synchronous machines: constitution, equivalent circuit, in no-load operation and in load, synchronization. Direct current machines: constitution, generalities, curves characteristics.
Topic IV: Basics of Electrical Installations	Introduction to electrical power systems. Introduction to aeronautical electrical installations. Basic electrical installations: Constitutive elements. Workload Estimate. Introduction to the installation calculation
Practices	- Laboratory Safety Standards. - Direct current: Association of elements - Alternating Current: Visualization and measurement of sine waves. Connection series - parallel. Balanced three-phase system. - Electrical Machines: Tests on motors and / or transformers.

## Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	20	40	60
Problem solving	20	20	40
Autonomous problem solving	0	27	27
Laboratory practical	10	10	20
Essay questions exam	3	0	3

\*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

## Methodologies

	Description
Lecturing	The professor will expose in the classes of large groups the contents of the matter.
Problem solving	Problems and type exercises will be exposed and solved in the classes of large groups as a guide for the students.
Autonomous problem solving	It is highly advisable that the student try to solve exercises and issues of the subject proposed by the professor.
Laboratory practical	Practical assemblies corresponding to the contents seen in the classroom will be made in the laboratory, or complementary aspects not treated in the theoretical classes will be treated.

## Personalized assistance

Methodologies	Description
Lecturing	The professor will personally attend the doubts and queries of the students.

Problem solving	The professor will personally attend the doubts and queries of the students.
Laboratory practical	The professor will personally attend the doubts and queries of the students.
Autonomous problem solving	The student will be able to attend tutorials to resolve any question related to the proposed problems.

Assessment					
	Description	Qualification	Training and Learning Results		
Autonomous problem solving	Written tests and / or works will be carried out to evaluate the resolution of autonomous problems, throughout the teaching period.	10	B1	C17	D1 D4 D5 D8
Laboratory practical	The fulfillment of the practices and the resolution of a questionnaire regarding the assembly, results obtained and interpretation of the same, will be valued positively. The fulfillment of each practice and presentation of the internship report will value between 0 and 10 points. For that it is essential to attend the practice the day and time set at the beginning of the course. There will be no recovery of practices. The evaluation of the set of practices is the arithmetic mean of the obtained scores. The non-presentation of a report of practices, will take the note of zero points in it. The deadline for the presentation of each practice will be established once it has been made.	20		C17	D1 D3 D4 D5 D6 D8
Essay questions exam	There will be a general examination with two sections, one corresponding to the contents of circuit theory and the other corresponding to machines and electrical installations, which may include both theoretical and application exercises. Each section will be valued from 0 to 10 points. The final qualification of this examination will be calculated using the arithmetic mean of both sections, although a minimum of a 3 in each of the parts will be required to overcome the matter. A partial examination, corresponding to the part of Theory of Circuits (Topics II of the section of Contents), will also be carried out. To pass this partial exam, the grade obtained will be equal or higher than 5 points out of 10, and they will have two options to introduce themselves to final exam: - Only the second section: electrical machines and installations (Topic III and IV of the section of Contents). In this case the partial exam qualification will be retained. - Doing the complete exam (two sections), if wanting to improve the grade in the first section. In this case, the score will correspond to the obtained in each of the sections of the complete examination, not keeping the partial exam qualification. In case the partial examination is not carried out or the student does not pass it, directly apply paragraphs 1 and 2 of this same section (examination general).	70	B1 B4	C17	D1 D3 D4 D5 D8 D13

#### Other comments on the Evaluation

The **calendar of the evaluation tests** is published in the webpage <http://aero.uvigo.es/gl/docencia/exames>.

It is considered by default that students will course the matter through the **on-site modality**. In case of students who want to take advantage of the out-site modality, due to facts such as job responsibilities or others in similar circumstances, they should contact the person in charge of the matter. These students will have to adduce reasonable and proven causes for such a decision and they will be addressed, in each case, how they will take the course and do the examinations on the "laboratory practices" and "resolution of autonomous problems" methodology. The rest of the evaluation will be the same as the on-site students.

The **final qualification** is calculated by means of the weighted average of the previous items.

Qualification = 0.10 x Resolution of autonomous problems + 0.20 x Practices + 0.70 x Examination

If a grade of 3 or lower is achieved in some parts of the general exam, and even if the global grade achieved is higher than 4.5, the maximum grade obtained will be 4.5.

The assistance to the practices and the resolution of autonomous problems are **continuous evaluation activities**.

The professor of this matter will allow the students to take a final exam in order to reach better qualifications, so those students willing to **improve their continuous evaluation qualifications** should take an **additional exam** following the general exam, which will include questions related to the contents of the teaching in "laboratory practices" and "resolution of autonomous problems", evaluable for 0 to 10, and that may even be the 30% of the final qualification. In such case, the qualification to be taken into account to assess the continuous evaluation activities will be the obtained in the additional exam.

For the **June-July second opportunity**, the last qualification in the **continuous evaluation** obtained during the course is kept, i.e. either the one obtained by means of the regular activities, or the one from the additional exam if done, without prejudice that (as in the December first opportunity) it can be surpassed for the passing of an additional exam. In this case, the qualification to take into account to assess the continuous evaluation activities will be the achieved in the last qualification.

Regarding the **qualifications obtained in the partial examination or in the December final examination**, the qualification of the section passed will be kept, until the June-July exam, if a score of 5 points out of 10 is achieved. Then, the student may:

- Only to the section not passed. In this case, the note of the section already passed will be retained.
- Doing the complete exam (two sections), of wanting to improve a qualification in the section already passed previously. In this case, the score will correspond to that obtained in each of the sections of the complete exam, not keeping the note of the section exceeded.

Each **new registration** in the matter **supposes a zeroing** of all the qualifications obtained in previous courses.

According to School normative: **The maximum duration of an exam** will be 3 hours if there is no break or 5 hours if there is an intermediate break (3 hours being the maximum for each part). So:

- the maximum duration of the general examination will be 3 hours (corresponding to 1.5 hours each section)
- if the student takes the additional exam corresponding to the continuous assessment part, it will be done once the exam is finished, after a break, and its maximum duration will be 1.5 hours.

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### Sources of information

#### Basic Bibliography

V. M. Parra, A. Pérez, A. Pastor, J. Ortega, **TEORÍA DE CIRCUITOS Vol. 1 y 2**, UNED, 2003

Suarez Creo J. y Miranda Blanco B.N., **MÁQUINAS ELÉCTRICAS. FUNCIONAMIENTO EN RÉGIMEN PERMANENTE**, 4ª, Editorial Tórculo, 2006

M. Plaza Fernández, **Electricidad en los aviones: Generación, utilización y distribución de energía eléctrica**, 6ª, Ediciones Paraninfo, 1981

R. Sanjurjo Navarro, **Sistemas eléctricos en aeropuertos**, AENA, 2004

#### Complementary Bibliography

F. Barrero, **Sistemas de Energía Eléctrica**, Thomson, 2004

R. Sanjurjo, E. Lázaro, **El sistema eléctrico en los aviones**, AENA, 2001

Jesús Fraile Mora, **Circuitos eléctricos**, Prentice Hall, 2015

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### Recommendations

#### Subjects that are recommended to be taken simultaneously

Mathematics: Mathematical methods/O07G410V01301

#### Subjects that it is recommended to have taken before

Physics: Physics I/O07G410V01103

Physics: Physics II/O07G410V01202

Mathematics: Linear algebra/O07G410V01102

Mathematics: Calculus I/O07G410V01101

Mathematics: Calculus II/O07G410V01201