



IDENTIFYING DATA

Circuits and electrical machines

Subject	Circuits and electrical machines			
Code	V09G311V01201			
Study programme	Grado en Ingeniería de los Recursos Mineros y Energéticos			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	1st
Teaching language	Galician English			
Department				
Coordinator	Miranda Blanco, Blanca Nieves Moreira Meira, Julio César			
Lecturers	Miranda Blanco, Blanca Nieves Moreira Meira, Julio César			
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General description	This class constitutes a basic course of circuit theory and fundamentals of electric machinery and batteries. The most important blocks are direct current and altern current circuits (single-phase and three-phase), transformers, synchronous and asynchronous machines and electric batteries.			

Training and Learning Results

Code	
A1	That the students demonstrate to possess and understand knowledge in an area of study that is part of the general education (second level), and often found at a level that, although based on advanced textbooks, also includes some aspects that involve knowledge from the avant-garde of the field of study
A2	That the students know how to apply their knowledge to their work or vocation in a professional way and that they possess the competences that are usually demonstrated through the elaboration and defense of arguments and the resolution of problems within their area of study
A3	That the students have the capability to gather and interpret relevant data (usually within their area of study) to issue judgments that include a reflection on relevant social, scientific or ethical issues
A4	That the students can transmit information, ideas, problems and solutions to a specialized and non-specialized audience
A5	That the students develop those learning capabilities necessary to undertake further studies with a high degree of autonomy.
B1	Scientific and technical training and qualification as a Mining Engineer and knowledge of the functions of consultancy, analysis, design, calculus, project, construction, maintenance, preservation and exploitation.
B2	To be familiar with the multiple technical and legal factors involved in the process of development, within the field of mining engineering, with the knowledge acquired in accordance with section 5 of order CIN/306/2009, pertaining to geological and mining prospecting and investigation, the explorations of all sorts of geological resources, including groundwater, underground construction, underground storage, treatment and benefit plants, energy plants, mineral processing and steel and iron plants, building materials plants, carbon chemistry, petrochemistry and gas plants, waste treatment and tributary plants, explosives factories, and ability to use well-tested methods and accredited technologies, with the aim of achieving the highest efficiency and ensuring the protection of the Environment and the safety and health of workers and users.
B3	Ability to design, write and plan partial or specific projects within the units specified in the previous section, such as mechanical and electric plants and their maintenance, networks of energy transportation, facilities for transportation and storage of solid, liquid and gaseous materials, waste sites, tailing dams, foundation and support, demolition, restoration, controlled explosions and explosives logistics.
B4	Ability to design, plan, run, inspect, sign and manage projects, plants or facilities, within their field.

- C17 Knowledge of the fundamentals of the electrical power system: generation of energy, transportation, distribution and delivery networks, as well as the types of lines and conductors. Knowledge of the regulations of high and low tension. Basic knowledge of electronics and control systems.
- D1 Ability to draw links between the different elements of all the knowledge they acquired, understanding them as components of a body of knowledge with a clear structure and strong internal cohesion.
- D3 To suggest and develop practical solutions, using the relevant theoretical knowledge, to phenomena and problems-situations of ordinary reality that are specific to engineering, developing appropriate strategies.
- D5 To be familiar with the relevant sources of information, including constant updating, in order to practice one's profession competently, accessing all the present and future tools of information search, constantly adapting to technological and social changes.
- D6 To be familiar with and to be able to use the legislation applicable in this sector, to be acquainted with the social and business environments and to be able to deal with the relevant administration, integrating this knowledge into the drawing up of engineering projects and into the implementation of every aspect of their professional work.
- D7 Ability to organize, understand, assimilate, produce and handle all the relevant information to develop their professional work, using appropriate computing, mathematical, physics tools, etc. when these are required.
- D8 Understanding engineering within a framework of sustainable development with environmental awareness.

Expected results from this subject

Expected results from this subject	Training and Learning Results			
	A1	B1	C17	D1
To master the analysis of electrical single-phase and three-phase circuits in steady state	A3		C17	D1 D5
To know the fundamentals of electrical machines operation	A1		C17	D1 D5
To know electronic devices for control of electrical machines	A1		C17	D1 D5
To know and deal with the basic concepts of the design of low voltage installations	A4		C17	D1 D3 D5 D6 D7 D8
To know the operation of electric power systems, generation, transmission, storage and distribution of the electric energy	A1 A2 A3 A4 A5	B1 B2 B3 B4	C17	D1 D5 D7 D8
To know the legislation applicable to electric power systems	A4		C17	D1 D3 D5 D6 D7 D8
To know the devices of a distribution network: lines, cables and electric equipment		B1	C17	D1 D6 D7 D8

Contents

Topic	
Direct current circuits	Steady-state analysis Variables, magnitudes and units Resistances Power and energy Basic equations, mesh analysis and nodal analysis The Thevenin theorem
Single-phase circuits	Steady-state analysis Variables, magnitudes and units Coils and capacitors Power and energy: instantaneous, mean, complex, apparent, real and reactive powers, power factor Basic equations, mesh analysis and nodal analysis The Thevenin theorem The Boucherot theorem of conservation of power

Balanced three-phase circuits	Steady-state analysis Variables, magnitudes and units Power and energy: complex, apparent, real and reactive powers, power factor Delta-wye and wye-delta conversions Equivalent single-phase circuits Representation in per unit values Resolution of electrical networks
Transformers	Fundamentals Equivalent electric circuit The ideal transformer The non ideal transformer
Rotating altern current electrical machines	Characteristics and operating principles Asynchronous machines Synchronous machines Equivalent electrical circuits Powers and torques
Electrochemical batteries	Principle of operation Equivalent electrical circuit

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	36	70	106
Practices through ICT	10	20	30
Laboratory practical	4	7.5	11.5
Essay questions exam	2.5	0	2.5

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

Methodologies

	Description
Lecturing	Explanation of the theory. Resolution of numerical examples
Practices through ICT	Simulation of numerical cases in computer laboratory
Laboratory practical	Use of electrical equipment

Personalized assistance

Methodologies	Description
Lecturing	The students will have the opportunity of asking the staff all questions related with the class
Practices through ICT	The students will have the opportunity of asking the staff all questions related with the class
Laboratory practical	The students will have the opportunity of asking the staff all questions related with the class

Assessment

	Description	Qualification	Training and Learning Results		
Lecturing	It includes solving of exercises similar to those explained during the masterclasses. Three partial written exams will be carried out, each one with a weight of 10% of the total mark, about monophasic circuits, triphasic circuits and electrical machines. Besides, an examination will be performed in the official date established in the calendar of the school. This exam will include contents about all the matter and will represent 40% out of the total qualification. Expected results of this subject: To master the analysis of electrical single-phase and three-phase circuits in steady state To know the fundamentals of electrical machines operation To know electronic devices for control of electrical machines To know and deal with the basic concepts of the design of low voltage installations To know the legislation applicable to electric power system	70	A1 A3	C17	D1 D3 D5 D6 D7 D8

Practices through ICT	It covers the attendance to the practices and the presentation of the reports about solving the proposed activities. To pass this part it is necessary to attend a minimum of 75% out of the practical classes. Expected results from this subject: To know the operation of electric power systems, generation, transmission, storage and distribution of the electric energy To know the devices of a distribution network: lines, cables and electric equipment	30	A1 A2 A3 A4 A5	B1 B2 B3 B4	C17	D5 D6 D7 D8
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Other comments on the Evaluation

CONSIDERATIONS ON CONTINUOUS ASSESSMENT

The final mark of the students selecting the continuous evaluation is obtained from the sum of the marks got in the partial tests, the final exam and the practices with the support of ICT.

CONSIDERATIONS ON THE GLOBAL EVALUATION

Students who refuse to carry out the continuous assessment will have the option of taking a final exam in which they will be able to obtain 100% of the grade.

In this case, the students will take two tests:

- Final exam: will account for 70% of the grade
- Test corresponding to practices with the support of ICT: it will mean 30%. This test may be replaced by the delivery of the practice report, in the case of students who attended at least 75% of the practices.

SECOND CHANCE CONSIDERATIONS

The conditions established for the first opportunity are maintained.

Sources of information

Basic Bibliography

Jesús Fraile Mora, **Máquinas eléctricas**, Ibergarceta,

José Fernández Moreno, **Teoría de circuitos**, Paraninfo,

Charles K. Alexander, Mathew N. O. Sadiku, **Fundamentals of electric circuits**, McGraw Hill,

Stephen J. Chapman, **Electric machinery fundamentals**, McGraw Hill,

Complementary Bibliography

Fermín Barrero, **Sistemas de energía eléctrica**, Paraninfo,

John Grainger, **Power system analysis**, McGraw Hill,

Recommendations

Subjects that it is recommended to have taken before

Physics: Physics II/V09G311V01107