



## Teaching Guide

Identifying Data					2024/25
Subject (*)	Electrical Machines	Code	730G04050		
Study programme	Grao en Enxeñaría en Tecnoloxías Industriais				
Descriptors					
Cycle	Period	Year	Type	Credits	
Graduate	1st four-month period	Third	Obligatory	6	
Language	Spanish				
Teaching method	Face-to-face				
Prerequisites					
Department	Enxeñaría Industrial				
Coordinador	Chouza Gestoso, Jesus Diego	E-mail	jesus.chouza@udc.es		
Lecturers	Chouza Gestoso, Jesus Diego	E-mail	jesus.chouza@udc.es		
Web	www.moodle.udc.es				
General description	That the student knows the principles of the main electrical machines and their modeling through circuits and electromechanical diagrams. The study is done in 5 blocks: power transformers or static machines, the principles of rotating electrical machines, direct current machines, alternating current induction machines and synchronous machines.				

## Study programme competences / results

Code	Study programme competences / results
A23	TEE1 Capacidade para o cálculo e deseño de máquinas eléctricas.
B2	CB2 Que os estudantes saiban aplicar os seus coñecementos ao seu traballo ou vocación dunha forma profesional e posúan as competencias que adoitan demostrarse por medio da elaboración e defensa de argumentos e a resolución de problemas dentro da súa área de estudo
B7	B5 Ser capaz de realizar unha análise crítica, avaliación e síntese de ideas novas e complexas
C1	C3 Utilizar as ferramentas básicas das tecnoloxías da información e as comunicacións (TIC) necesarias para o exercicio da súa profesión e para a aprendizaxe ao longo da súa vida.
C4	C6 Valorar criticamente o coñecemento, a tecnoloxía e a información dispoñible para resolver os problemas cos que deben afrontarse.
C5	C7 Asumir como profesional e cidadán a importancia da aprendizaxe ao longo da vida.

## Learning outcomes

Learning outcomes	Study programme competences / results		
Poseer a capacidade para o cálculo e o deseño de máquinas eléctricas	A23	B2 B7	C1 C4 C5

## Contents

Topic	Sub-topic



<p>The two blocks that divide the five subjects, develop the contents established in the file of the Verification Report.</p>	<p>BLOCK I. STATIC MACHINES.</p> <ul style="list-style-type: none"><li>- Power transformers (CONTENTS: Basis of electrical machines and power transformers).</li></ul> <p>BLOCK II. ROTATING MACHINES.</p> <ul style="list-style-type: none"><li>- General principles of rotating electrical machines (CONTENTS: Basis of electrical machines).</li><li>- Direct current machines (CONTENTS: Direct current machines).</li><li>- Synchronous alternating current machines (CONTENTS: Alternating current machines).</li><li>- Induction alternating current machines (CONTENTS: Alternating current machines).</li></ul>
<p>Power transformers.</p>	<ul style="list-style-type: none"><li>* Need for the transformer.</li><li>* Transformer power and parts.</li><li>* Characteristic plate.</li><li>* Coil with iron core.</li><li>* Excitation or vacuum current of a transformer.</li><li>* Principle of operation of an ideal transformer (single-phase).</li><li>* Operation of a real transformer.</li><li>* Equivalent circuit of a transformer.</li><li>* Determination of homologous terminals.</li><li>* Vacuum test.</li><li>* Short circuit test.</li><li>* Voltage drop in a transformer, Ferranti effect. Load index.</li><li>* Losses and performance of a transformer.</li><li>* Connecting current of a transformer.</li><li>* Three-phase transformers.</li><li>* Harmonics in excitation currents (three single-phase).</li><li>* Connections of three-phase transformers.</li><li>* Hourly indexes.</li><li>* Parallel coupling of transformers.</li><li>* Autotransformers.</li><li>* Regulation sockets.</li><li>* Meter transformers.</li><li>* Voltage transformers.</li><li>* Current transformers.</li></ul>
<p>General principles of rotating electrical machines.</p>	<ul style="list-style-type: none"><li>* Basic elements of electrical machines</li><li>* Delgas collector and ring collector.</li><li>* Winding.</li><li>* Losses and heating.</li><li>* Rated or nominal power. Types of service</li><li>* Magnetic field and m.m.f. in the air gap of an electrical machine.</li><li>* Magnetic field and e.m.f. produced by a concentrated winding of diametral pitch.</li><li>* F.m.m. produced by a distributed winding</li></ul>



Asynchronous alternating or induction machines.	<ul style="list-style-type: none"> <li>* F.m.m. produced by a three-phase winding. Rotating fields. Ferraris theorem.</li> <li>* Relationship between an alternating field and a rotating field. Leblanc's theorem.</li> <li>* Constructive aspects (slip).</li> <li>* Principle of operation (angular velocity of the magnetic field cutting the rotor conductors).</li> <li>* Approximate equivalent circuit of the asynchronous motor.</li> <li>* Asynchronous motor tests: Vacuum or free rotor test and short-circuit or locked rotor test.</li> <li>* Power (active) in the synchronous machine.</li> <li>* Rotation torque.</li> <li>* Characteristic curves.</li> <li>* Asynchronous machine as generator and in brake effect (types of operation).</li> <li>* Starting of the asynchronous machine (squirrel cage and wound rotor motors).</li> </ul>
Synchronous alternating machines.	<ul style="list-style-type: none"> <li>* Construction principles.</li> <li>* Principle of alternator operation.</li> <li>* Armature reaction.</li> <li>* Equivalent circuit and vector diagram in the synchronous machine.</li> <li>* Characteristic curves.</li> <li>* Synchronous impedance. Vacuum and short-circuit test and Potier's method (or null fdp).</li> <li>* Regulation of outgoing pole machines.</li> <li>* Synchronous motor: generalities.</li> <li>* Coupling of an alternator to the network.</li> <li>* Active and reactive power developed by a synchronous machine coupled to an infinite power network.</li> <li>* Operation of a synchronous machine connected to an infinite power grid.</li> </ul>
Direct current machines.	<ul style="list-style-type: none"> <li>* Constructive aspects.</li> <li>* Principle of operation.</li> <li>* Armature reaction.</li> <li>* Commutation.</li> <li>* DC generators: General aspects.</li> <li>* DC generators: Service characteristics.</li> <li>* DC motors: General aspects.</li> <li>* D.C. Motors: Operating characteristics curves.</li> <li>* DC motors with independent excitation and shunt.</li> <li>* DC motors with series excitation.</li> <li>* DC motors with compound excitation. Ward-Leonard system.</li> <li>* DC motor: Braking methods.</li> <li>* Single-phase AC motors with delgas collector.</li> <li>* Brushless DC motors (brushless motors).</li> </ul>

Planning				
Methodologies / tests	Competencies / Results	Teaching hours (in-person & virtual)	Student's personal work hours	Total hours
Guest lecture / keynote speech	A23 B2 B7 C1 C4 C5	30	23	53
Supervised projects	A23	20	38	58
Laboratory practice	A23 B2 B7 C1 C4 C5	10	10	20
Mixed objective/subjective test	A23 B2 B7 C1 C4 C5	4	12	16
Personalized attention		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

Methodologies	Description
Guest lecture / keynote speech	Oral presentation complemented by the use of audiovisual media and the introduction of some questions addressed to the students, with the purpose of transmitting knowledge and facilitating learning.
Supervised projects	Methodology designed to promote autonomous learning of students, under the guidance of the teacher and in varied scenarios
Laboratory practice	Methodology that allows students to learn effectively through practical activities You cannot pass the subject without attending the laboratory practices.
Mixed objective/subjective test	Integrates objective test type questions that combine multiple response questions

## Personalized attention

Methodologies	Description
Laboratory practice Supervised projects	O profesor responde a las , ás preguntas ou consultas realizadas polos alumnos.

## Assessment

Methodologies	Competencies / Results	Description	Qualification
Laboratory practice	A23 B2 B7 C1 C4 C5	Completion with the use of laboratory practices is essential to pass the subject. The laboratory practice exam will represent 1% of the final grade for the subject, as long as the student obtains 4.5 points. out of 10 in the objective test, in no case can it serve to compensate grades lower than 4.5 pts, in the Mixed Test.	1
Mixed objective/subjective test	A23 B2 B7 C1 C4 C5	The mixed test that will be carried out at the end of the course, in the corresponding official calls, where the student must demonstrate their degree of learning in an objective way. They will consist of two parts with a number between 10 and 15 multiple choice questions in each of the parts, accompanied by 6 possible answers, where only one is correct, the student must always justify the answer, this being an essential condition for the answer is accepted as correct. Incorrect answers will deduct 0.17 points. To pass the subject the student must obtain 4.5 points. out of 10, at least in each of the two parts of this test.	69
Supervised projects	A23	These are practical cases proposed by the teacher, which must be resolved and explained through an oral presentation.	30

## Assessment comments

- The subject is divided into 2 parts, at the end of the presentation of the 1st part coinciding with the middle of the school period, a voluntary test will be carried out, which will be eliminatory, the students who pass it will no longer have to take the same exam again in the calls for the 1st and 2nd opportunity of the course where they passed the 1st part.
- The evaluation criteria will be the same for the 1st and 2nd opportunity and similar tests.
- Class attendance is recommended, being mandatory in laboratory practices.
- The fraudulent performance of tests or evaluation activities, once proven, will directly imply a failure grade in the call in which it is committed: the student will be graded with ?fail? (numerical grade 0) in the corresponding call of the academic year, whether the commission of the offense occurs on the first opportunity or on the second. For this, your qualification will be modified in the first opportunity report, if necessary.

## Sources of information



<b>Basic</b>	<ul style="list-style-type: none"> <li>- Fraile Mora, Jesús (2008). Máquinas Eléctricas. McGraw-Hill</li> <li>- Fraile Mora, Jesús; Fraile Ardamuy, Jesús (2005). Problemas de Máquinas Eléctricas. McGraw-Hill</li> <li>- Ortega Jinénez, Guillermo; Gómez Alós, Milagros; Bachiller Soler, Alfonso (2002). Problemas resueltos de Máquinas Eléctricas. Thomson-Paraninfo</li> <li>- Chapman, S J (2005). Máquinas Eléctricas. Mc Graw Hill</li> <li>- Mazón, J ; Miñambres, J F; Zorrozuza, M A ; Buigues G ; Valverde V. (2008). Guía de autoaprendizaje de máquinas eléctricas . Pearson Prentice Hall</li> <li>- ( ) . .</li> </ul>
<b>Complementary</b>	<ul style="list-style-type: none"> <li>- Fitzgerald, A.E; Kingsley Jr., Charles; Umans, Stephen D. (2003). Máquinas Eléctricas. McGraw-Hill</li> </ul>

## Recommendations

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

Fields and Waves/730G04047  
 CÁLCULO/730G04001  
 FÍSICA I/730G04003  
 ÁLXEBRA/730G04006  
 FÍSICA II/730G04009  
 ECUACIONES DIFERENCIAIS/730G04011  
 FUNDAMENTOS DE ELECTRICIDADE/730G04012  
 Informática/770G02002

### Subjects that are recommended to be taken simultaneously

### Subjects that continue the syllabus

### Other comments

Para unha contorna sostible e cumprir co obxectivo da actuación núm. 1: a entrega dos traballos documentais que se realicen na materia: For a sustainable environment and to comply with the objective of action nº 1: the delivery of the documentary works that are carried out in the material: 1.1. They 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 made on paper: - Plastics will not be used. - Double-sided prints will be made. - Recycled paper will be used. - Printing of drafts will be avoided.

(\*)The teaching guide is the document in which the URV publishes the information about all its courses. It is a public document and cannot be modified. Only in exceptional cases can it be revised by the competent agent or duly revised so that it is in line with current legislation.