



## IDENTIFYING DATA

### Electrical machines

Subject	Electrical machines			
Code	V12G360V01605			
Study programme	Degree in Industrial Technologies Engineering			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	3rd	2nd
Teaching language	Spanish Galician			
Department	Electrical Engineering			
Coordinator	Prieto Alonso, Manuel Angel			
Lecturers	Novo Ramos, Bernardino Prieto Alonso, Manuel Angel			
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Web	<a href="http://faiticuvigo.es">http://faiticuvigo.es</a>			
General description	(*)O obxectivo desta materia é dotar ao alumno dunha formación básica, tanto teórica como práctica, sobre as máquinas eléctricas rotativas, en canto á constitución, modos de funcionamento e aplicacións.			

## Competencies

### Code

CG3 CG3 Knowledge in basic and technological subjects that will enable them to learn new methods and theories, and equip them with versatility to adapt to new situations.

CE10 CE10 Knowledge and use of the principles of circuit theory and electrical machines.

CT1 CT1 Analysis and synthesis.

CT2 CT2 Problems resolution.

CT6 CT6 Application of computer science in the field of study.

CT14 CT14 Creativity.

CT16 CT16 Critical thinking.

CT17 CT17 Working as a team.

CT19 CT19

## Learning outcomes

Learning outcomes	Competences		
To understand the basic aspects of the construction and operation of the classical electric machines.	CG3	CE10	CT1 CT16
To master the experimental process used to characterise the different types of E.M.	CG3	CE10	CT1 CT2 CT6 CT16 CT17
To know the industrial use of the different types of E.M.	CG3		CT1 CT14 CT16 CT19
To understand the difference between 'classical' and 'modern' E.M.	CG3	CE10	

## Contents

### Topic

UNIT I: INTRODUCTION TO THE ELECTRICAL MACHINES	I-1 Electromagnetic and electro-mechanic fundamental laws. General behaviour notes: Physical arrangement of the electrical machines. Types of machines. Losses. Energy balance. Efficiency. Heating. Cooling. Rated power. Insulation types. Degrees of mechanical protection and construction types. Nameplate. I-2 Principles of Construction. Magnetic poles. Neutral line. Pole-pitch. I-3 M.M.F[s] and E.M.F[s] inside the machine: Fields generated with concentrated and distributed windings. Rotating magnetic field. Winding factor.
UNIT II: INDUCTION MOTORS (ASYNCHRONOUS)	II-1 Three-phase induction machine Construction characteristics. Operating principles. Electrical equivalent circuit. Powers and torques. Electrical tests. Energy balance and efficiency. T-s curve. Operation modes. Starting methods and speed control. II-2 Single-phase induction motor Construction characteristics. Operating principles. Electrical equivalent circuit. Starting methods. UNIT III: SYNCHRONOUS MACHINES (GENERATORS) Construction characteristics. Operating principles. Armature reaction. Salient poles and cylindrical rotor machines. Electrical equivalent circuit. Stand-alone and grid-connected behaviours. Synchronous motor: Characteristics and uses
UNIT III: SYNCHRONOUS MACHINES (GENERATORS)	Construction characteristics. Operating principles. Armature reaction. Salient poles and cylindrical rotor machines. Electrical equivalent circuit. Stand-alone and grid-connected behaviours. Synchronous motor: Characteristics and uses.
UNIT IV: D.C. MOTORS. SPECIAL MACHINES	IV-1 Construction characteristics. Operating principles. Excitation systems. Armature reaction. Commutation. Armature reaction. Speed control. IV-2 Special machines: Step Motors, PMDC, Reluctance Motors
UNIT V: PROTECTION AND CONTROL OF ELECTRICAL MOTORS	Low voltage switch gear. Electrical machines protection systems.

### Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	32.5	65	97.5
Laboratory practices	10	16	26
Problem solving	8	16	24
Objective questions exam	1	0	1
Problem solving	1.5	0	1.5

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

### Methodologies

	Description
Lecturing	(*) Exposición por parte do profesor dos contidos sobre a materia de máquinas eléctricas.
Laboratory practices	(*) Actividades de aplicación dos coñecementos teóricos a situacións concretas e de adquisición de habilidades básicas e procedimentales relacionadas coas máquinas eléctricas rotativas. Desenvolverase no laboratorio de máquinas eléctricas correspondente.
Problem solving	(*) Actividade na que se formulan problemas e exercicios relacionados coa materia de máquinas eléctricas rotativas. O profesor resolverá problemas tipo de máquinas rotativas e o alumno debe resolver problemas similares.

### Personalized attention

Methodologies	Description
Lecturing	Any question can be arised during the lessons. Office hores are also available for the students
Laboratory practices	During the realization of the practical tests any possible question will be solved.
Problem solving	All numerical exercices will be solved in this classes. Q and A will be highly recommended.

### Assessment

Description	Qualification	Evaluated Competencess

Laboratory practices	The evaluation of the practical laboratory tests will be done in a continuous way (session to session). The evaluation criteria is : - Minimum attendance of 80%. - Punctuality . - Previous preparation of the practical test. - Correct utilization of the material . □ Practical tests results, if required . Not attending the lab lessons will imply 0 point in this part. Attendance below 80% will imply 0 point in this part. To pass the whole subject, a mark higher than 40% in this part in mandatory.	10	CG3	CE10	CT1 CT2 CT14 CT16 CT17 CT19
Problem solving	The evaluation of the exercises will be done in a continuous way (session to session). The evaluation criteria is : - Minimum attendance of 80%. - Punctuality . - Previous preparation of the exercise, if required. . □ Correct exercise result, if required.	5	CG3	CE10	CT1 CT2 CT6 CT16
Objective questions exam	The assessment method will be a multiple choice test, to be done individually without the use of any information source. There will be one unique test for the whole subject, and it will cover not only the theoretical lessons but the practical lab tests. A minimum mark of 40% will be required in this part.	55	CG3	CE10	CT1 CT6
Problem solving	The assessment method will be a numerical resolution of an exercise of electrical machines A minimum mark of 40% will be required in this part.	30		CE10	CT1 CT2 CT14 CT16

### Other comments on the Evaluation

Second attempt (July)

If a student does not reach an 80% for the lab lessons or his/her marks are not higher the minimum required, a practical exam will be necessary to pass this part.

To pass the subject a minimum of 5/10 will be required (result of the sum of the 4 subject parts)

Commitment: An student ethical behaviour is expected. If not ethical behaviour is detected (copying, cheating in any way, using unlicensed electronic devices, and others), it will considered that the student does not gather the necessary requirements to pass the subject.

In this case the global qualification in the present academic course will be (0.0). (FAILED)

### Sources of information

#### Basic Bibliography

Jesús Fraile Mora, **Máquinas Eléctricas**, McGraw-Hill/Interamericana de España S.A.U,

Jesús Fraile Mora y Jesús Fraile Ardanuy, **Problemas de Máquinas Eléctricas**, McGraw-Hill/Interamericana de España, Stephen J. Chapman, **Máquinas Eléctricas**, McGraw-Hill,

Manuel Cortés Cherta, **Curso Moderno de Máquinas Eléctricas Rotativas (I,II,III)**, Editores Técnicos Asociados,

#### Complementary Bibliography

Javier Sanz Feito, **Máquinas Eléctricas**, Prentice Hall, 2002

Sanjurjo Navarro, **Máquinas Eléctricas**, García-Maroto, 2011

Suárez Creo, Juan M, **Máquinas eléctricas : funcionamiento en régimen permanente**, Tórculo, 2006

Fitzgerald, Arthur Eugene, **Máquinas Eléctricas**, McGraw-Hill, 2004

### Recommendations

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

Physics: Physics 1/V12G360V01102

Physics: Physics 2/V12G360V01202

Basics of circuit analysis and electrical machines/V12G360V01302

Applied electrotechnics/V12G360V01501

**Other comments**

Requirements: To enrol in this subject is necessary to surpass or well be enrolled of all the subjects of the inferior courses to the course in the that is situated this subject.

In case of discrepancies, will prevail the version in Castilian of this guide.

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