

## [GJL101] ELECTRICAL MACHINES

### GENERAL INFORMATION

<b>Studies</b>	DEGREE IN MECHATRONICS ENGINEERING		<b>Subject</b>	?
<b>Semester</b>	1	<b>Course</b>	2	<b>Mention / Field of specialisation</b>
<b>Character</b>	OPTIONAL		<b>Language</b>	EUSKARA
<b>Plan</b>	2020	<b>Modality</b>	Face-to-face	<b>Total hours</b>
<b>Credits</b>	6	<b>Hours/week</b>	5	90 class hours + 60 non-class hours = <b>150 total hours</b>

### PROFESSORS

ALMANDOZ LARRALDE, GAIZKA
SARASOLA ALTUNA, IZASKUN

### REQUIRED PREVIOUS KNOWLEDGE

Subjects	Knowledge
(No specific previous subjects required)	(No previous knowledge required)

### SKILLS

#### VERIFICA SKILLS

##### SPECIFIC

**GJCE25** - To know and use the principles of circuit theory and electrical machines

##### GENERAL

**GJCG03** - Addressing and optimising activities of assembly, commissioning, assistance and maintenance of facilities, machinery, and industrial mechatronic systems

**GJCG05** - Developing and designing products, equipment and mechatronic systems while complying with the technical, economic, quality and safety requirements established in the specifications and required by current legislation

##### CROSS

**GJCTR2** - To be able to understand and apply knowledge to problem solving in complex work situations or specialised and professional environments calling for creative and innovative ideas, using self-developed arguments and procedures;

##### BASIC

**G\_CB5** - To have developed learning abilities required to embark on subsequent studies with a high level of autonomy.

### LEARNING RESULTS

**RG201** They coordinate their work with the other members of the team, contribute in their team to the development of the tasks to be carried out and the creation of a good working climate.

#### LEARNING ACTIVITIES

	CH	NCH	TH
Development, writing and presentation of memorandums, reports, audiovisual material, etc.	2 h.	2 h.	4 h.
Relating to projects/POPBLs carried out individually or in teams			

#### EVALUATION SYSTEM

	W
Technical skills, involvement in the project, finished work, obtained results, handed documentation, presentation and technical defence	100%

#### MAKE-UP MECHANISMS

Technical skills, involvement in the project, finished work, obtained results, handed documentation, presentation and technical defence
-----------------------------------------------------------------------------------------------------------------------------------------

**Comments:** With second semester project

**CH - Class hours:** 2 h.

**NCH - Non-class hours:** 2 h.

**TH - Total hours:** 4 h.

**RG202** They make decisions and assess the possible consequences of the selected alternative.

#### LEARNING ACTIVITIES

	CH	NCH	TH
Development, writing and presentation of memorandums, reports, audiovisual material, etc.	2 h.	2 h.	4 h.
Relating to projects/POPBLs carried out individually or in teams			

#### EVALUATION SYSTEM

	W
Technical skills, involvement in the project, finished work,	100%

#### MAKE-UP MECHANISMS

Technical skills, involvement in the project, finished work, obtained
-----------------------------------------------------------------------

obtained results, handed documentation, presentation and technical defence

results, handed documentation, presentation and technical defence

**Comments:** With the second semester project

**CH - Class hours:** 2 h.

**NCH - Non-class hours:** 2 h.

**TH - Total hours:** 4 h.

**RG204** They define the problem, the development of the solution, as well as the conclusions in an effective way, making a correct use of the language, in writing.

**LEARNING ACTIVITIES**

Development, writing and presentation of memorandums, reports, audiovisual material, etc.  
Relating to projects/POPBLs carried out individually or in teams

**CH**

**NCH**

**TH**

3 h.

1 h.

4 h.

**EVALUATION SYSTEM**

**W**

Technical skills, involvement in the project, finished work, obtained results, handed documentation, presentation and technical defence

100%

**MAKE-UP MECHANISMS**

Technical skills, involvement in the project, finished work, obtained results, handed documentation, presentation and technical defence

**Comments:** Revision and correction of the written report of the semester project

**CH - Class hours:** 3 h.

**NCH - Non-class hours:** 1 h.

**TH - Total hours:** 4 h.

**RG205** They define the problem, the development of the solution, as well as the conclusions in an effective way, making a correct use of the language, orally.

**LEARNING ACTIVITIES**

Development, writing and presentation of memorandums, reports, audiovisual material, etc.  
Relating to projects/POPBLs carried out individually or in teams

**CH**

**NCH**

**TH**

2 h.

1 h.

3 h.

**EVALUATION SYSTEM**

**W**

Technical skills, involvement in the project, finished work, obtained results, handed documentation, presentation and technical defence

100%

**MAKE-UP MECHANISMS**

Technical skills, involvement in the project, finished work, obtained results, handed documentation, presentation and technical defence

**Comments:** With the oral presentation of the project of the second semester

**CH - Class hours:** 2 h.

**NCH - Non-class hours:** 1 h.

**TH - Total hours:** 3 h.

**RGJ212** They analyze single-phase transformers, three-phase transformers and instrument transformers.

**LEARNING ACTIVITIES**

Development, writing and presentation of memorandums, reports, audiovisual material, etc.  
Relating to projects/POPBLs carried out individually or in teams

**CH**

**NCH**

**TH**

5 h.

4 h.

9 h.

Individual study and work, tests and evaluations and check points

3 h.

7 h.

10 h.

Presentation of the teacher in the classroom, in participatory classes, of concepts and procedures associated with the subjects

7 h.

7 h.

Individual and team exercises

9 h.

4 h.

13 h.

Individual or team workshop and/or lab practice

4 h.

3 h.

7 h.

<b>EVALUATION SYSTEM</b>	<b>W</b>	<b>MAKE-UP MECHANISMS</b>
Individual written and oral tests to assess technical skills of the subject	70%	Individual written and oral tests to assess technical skills of the subject
Reports of solving exercises, case studies, computer practices, simulation practices and laboratory practices	10%	<b>Comments:</b> Final mark: Test * 0.25 + Retake exam * 0.75
Technical skills, involvement in the project, finished work, obtained results, handed documentation, presentation and technical defence	20%	
<b>Comments:</b> A question about the practice will be done in the test. If the practice is not done, the student can not do the test		
<b>CH - Class hours:</b> 28 h.		
<b>NCH - Non-class hours:</b> 18 h.		
<b>TH - Total hours:</b> 46 h.		

**RGJ213** They analyze DC machines and select the right machine for a real application.

<b>LEARNING ACTIVITIES</b>	<b>CH</b>	<b>NCH</b>	<b>TH</b>
Development, writing and presentation of memorandums, reports, audiovisual material, etc.	6 h.	2 h.	8 h.
Relating to projects/POPBLs carried out individually or in teams			
Individual study and work, tests and evaluations and check points	2 h.	5 h.	7 h.
Presentation of the teacher in the classroom, in participatory classes, of concepts and procedures associated with the subjects	3 h.		3 h.
Individual and team exercises	8 h.	5 h.	13 h.
Workshops, discussions, seminars, case studies, role plays, etc	4 h.	3 h.	7 h.

<b>EVALUATION SYSTEM</b>	<b>W</b>	<b>MAKE-UP MECHANISMS</b>
Individual written and oral tests to assess technical skills of the subject	70%	Individual written and oral tests to assess technical skills of the subject
Reports of solving exercises, case studies, computer practices, simulation practices and laboratory practices	10%	<b>Comments:</b> Final mark: Test * 0.25 + Retake exam * 0.75
Technical skills, involvement in the project, finished work, obtained results, handed documentation, presentation and technical defence	20%	
<b>Comments:</b> A question about the practice is asked in the test. It is mandatory to do the practice for taking the test		
<b>CH - Class hours:</b> 23 h.		
<b>NCH - Non-class hours:</b> 15 h.		
<b>TH - Total hours:</b> 38 h.		

**RGJ214** They analyze alternating current machines: they select the required motor and the components to set the electrical manoeuvre necessary to start different types of machine.

<b>LEARNING ACTIVITIES</b>	<b>CH</b>	<b>NCH</b>	<b>TH</b>
Development, writing and presentation of memorandums, reports, audiovisual material, etc.	9 h.	4 h.	13 h.
Relating to projects/POPBLs carried out individually or in teams			
Individual study and work, tests and evaluations and check points	2 h.	10 h.	12 h.
Presentation of the teacher in the classroom, in participatory classes, of concepts and procedures associated with the subjects	6 h.		6 h.
Individual and team exercises	13 h.	7 h.	20 h.

<b>EVALUATION SYSTEM</b>	<b>W</b>	<b>MAKE-UP MECHANISMS</b>
Individual written and oral tests to assess technical skills of the subject	80%	Individual written and oral tests to assess technical skills of the subject
Technical skills, involvement in the project, finished work, obtained results, handed documentation, presentation and technical defence	20%	<b>Comments:</b> first test*0.25 + second test*0.75

**CH - Class hours:** 30 h.  
**NCH - Non-class hours:** 21 h.  
**TH - Total hours:** 51 h.

## CONTENTS

1. Magnetism
2. Transformers
  - 2.1. Single-phase transformers
  - 2.2. Three-phase transformers
  - 2.3. Characterisation of the transformer
3. DC current machines
  - 3.1. Working principles
  - 3.2. Machine types
  - 3.3. Characterisation
  - 3.4. Steady-state analysis
4. Synchronous generator
  - 4.1. Working principles
  - 4.2. Characterisation
  - 4.3 Steady-state analysis
  - 4.4. Generators connected to electric grid
  - 4.5. Generators working at island mode
5. Asynchronous machines
  - 5.1. Working principles
  - 5.2. Machine types
  - 5.3. Characterisation
  - 5.4. Steady-state analysis

## LEARNING RESOURCES AND BIBLIOGRAPHY

### Learning resources

Slides of the subject  
Lab practical training  
Moodle Platform

### Bibliography

Fraille Mora, Jesús; Máquinas Eléctricas; UPM; 1993  
[http://katalogoa.mondragon.edu/janium-bin/janium\\_login\\_opac\\_re\\_Ink.pl?grupo=MECATRONICA21&ejecuta=30&\\_ST](http://katalogoa.mondragon.edu/janium-bin/janium_login_opac_re_Ink.pl?grupo=MECATRONICA21&ejecuta=30&_ST)