VNIVERSITAT DE VALÈNCIA

Course Guide
34934 Electric machines

COURSE DATA

Data Subject	
Code	34934
Name	Electric machines
Cycle	Grade
ECTS Credits	6.0
Academic year	2022 - 2023

Study (s)

Degree	Center	Acad. year	Period
1404 - Degree in Industrial Electronic Engineering	School of Engineering	3	Second term

Subject-matter

Degree	Subject-matter	Character
1404 - Degree in Industrial Electronic Engineering	15 - Electrotechnics	Obligatory

Coordination

Name	Department
GIRBES JUAN, VICENT	242 - Electronic Engineering

SUMMARY

This is an obligatory subject taught in the second semester of the third curse of the Industrial Electronics Engineering degree. It weights 6 ECTS (European credits). The student dedication is estimated in 150 hours, from which 60 are classroom hours and 90 are non-classroom hours.

The subject "Electrical Machines", together with the subject "Electrical Technology", form the matter "Electrotecnics" and pretends to give students the necessary knowledge about the world of electrical machines.

Throughout the course different types of electrical machines will be studied, from transformers to rotating electrical machines. Specifically, the types of rotating electrical machines to be studied during the course are:

- DC machines
- Asynchronous or induction machines
- Synchronous machines

The subject is an important block within the degree, due to the study and theoretical analysis of the electrical machines as well as the proposed laboratory sessions, which offers students the opportunity to acquire a complete theoretical and practical basis.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

For the normal teaching of the subject it is advisable that students knowing the concepts taught in other subjects of the degree as Mathematics I, Mathematics II, Mathematics III, Physics A, Physics B and Fundamentals of Electrical and Electronics.

OUTCOMES

1404 - Degree in Industrial Electronic Engineering

- CG3 - Knowledge of basic and technological subjects that allows students to learn new methods and theories and provides them with versatility to adapt to new situations.
- CG4 - Ability to solve problems with initiative, decision-making skills, creativity and critical reasoning and to communicate and transmit knowledge, abilities and skills in the field of industrial engineering (with specific industrial electronics technology).
- CG6 - Ability to deal with specifications, regulations and mandatory standards.
- CE1 - Applied knowledge of electrical engineering.

LEARNING OUTCOMES

After having passed the subject, the student should have earned a bundle of skills, among which are:

• Understand the principle of operation of power transformers (CG3, CE1).

• Knowledge and understanding of the constitution and principles of operation of the main electrical machines used in industry (CG3).

• Proficiency in solving basic calculations operation of electrical machines (CG3, CG4, CG6, CE1).

In addition, it is intended that students acquire the following skills:

• Understand the basic components of electrical machines.

• Know the different types of machines and their operating principles and main applications.

• Know the models for the analysis of electrical machines.

• Knowing the experimental management of electrical machines by laboratory testing.

• Knowing how to select the type of electrical machine best suited for a particular real situation

DESCRIPTION OF CONTENTS

1. Fundamentals of magnetic circuits and the power conversion

1.1 Introduction
1.2 Magnetic materials
1.3 Laws of magnetic circuits
1.4 Permanent magnets
1.5 Energy and losses in ferromagnetic cores
1.6 Magnetic circuits excited by AC
1.7 Energy conversion

2. General principles of electrical machines

2.1 Introduction
2.2 Basic elements of electrical machines
2.3 Losses and heating
2.4 Rated power and efficiency
2.5 Magnetomotive force and magnetic field
2.6 Force-induced electromotive
2.7 Electromagnetic torque
2.8 Overall analysis of electrical machines

3. Transformers

3.1 Introduction
3.2 Constructive aspects
3.3 Ideal transformer
3.4 Real transformer. Equivalent Circuit
3.5 Transformer laboratory tests
3.6 Voltage drop and efficiency losses
3.7 Excitation current and inrush current
3.8 Three-phase transformers
3.9 Parallel coupling
3.10 Autotransformers
3.11 Measurement transformers

4. DC machines

4.1 Introduction
4.2 Constructive aspects
4.3 Principle of operation
4.4 Reaction of the armature
4.5 Switching
4.6 Generators
4.7 Motors
4.8 Speed control
4.9 Methods for braking
4.10 Electrical drives
4.11 Control structures
4.12 Special motors

5. Asynchronous machines

5.1 Introduction
5.2 Constructive aspects
5.3 Principle of operation and equivalent circuit
5.4 Laboratory tests
5.5 Power losses
5.6 Electromagnetic torque and operation
5.7 Model of asynchronous motor
5.8 Starting
5.9 Speed regulation
5.10 Single phase induction motor
5.11 Special asynchronous machines
5.12 Electric drives and control structures

6. Synchronous machines

6.1 Introduction
6.2 Constructive aspects
6.3 Excitation systems
6.4 Principle of operation and phasor diagram
6.5 Linear analysis of the smooth roll rotor synchronous machine
6.6 Laboratory tests and obtaining the synchronous impedance
6.7 Linear analysis of the salient pole stator synchronous machine
6.8 Laboratory test and obtaining the synchronous reactances
6.9 Island mode of alternator
6.10 Grid mode of alternator
6.11 Synchronous motor. Features and applications

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	30,00	100
Laboratory practices	20,00	100
Classroom practices	10,00	100
Development of individual work	5,00	0
Study and independent work	40,00	0
Readings supplementary material	5,00	0
Preparation of evaluation activities	10,00	0
Preparing lectures	5,00	0
Preparation of practical classes and problem	25,00	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

• THEORY CLASSES: Theory classes will be taught in masterfully way. Different questions will be proposed by the teacher to determinate the level of knowledge acquired by the students in the preparation work of each of the issues (CG3, CG6, CE1). Theory classes and problems will be in a classroom with computers. The student will have access to educational materials related to course content (slides, articles, web addresses, additional references, etc..), through the Virtual Classroom, an application developed by the University of Valencia which permits an easy access to different types of teaching resources and/or administrative.

• PROBLEM CLASSES: Classes of problems will be taught in the theory classroom. In the classes of problems will be solved some of the most significant problems listed in the problems pack of the subject (CG4, CG6, CE1). In the same way as for the theory classes, students have access to all teaching material in the Virtual Classroom.

• LABORATORY CLASSES: Laboratory classes will be taught in the laboratories of the Centre. The teacher will evaluate students on knowledge and understanding of the practice (CG4, CG6, CE1).

EVALUATION

For the first call, the student will be able to choose between two modalities of evaluation:

a) CONTINUOUS EVALUATION modality:

- Evaluation of the theory-problem part (nota_teorpro):

The mark will be obtained from the performance of two individual tests throughout the semester (CG3, CG4, CG6, CE1) and will be calculated as the arithmetic mean of both partial exams:

nota_teorpro = (nota_p1 + nota_p2) / 2

The mark obtained in each test must be equal to or higher than 5 (out of 10). Otherwise, nota_teorpro = min(nota_p1, nota_p2), so the student must take the final exam mode to pass the subject.

- Evaluation of the laboratory part (note_lab):

The laboratory grade will be obtained from the evaluation of the 6 laboratory practices (up to a maximum of 5 out of 10) (CG4, CG6, CE1) and the performance of three individual tests throughout the semester (up to a maximum of 5 out of 10) (CG3, CG4, CG6, CE1). The average mark obtained must be equal to or higher than 5 (out of 10). Otherwise, the student must take the final exam to pass the subject.

b) FINAL EXAMINATION modality:

A final examination of theory-problems and laboratory will be carried out on the date set by the center, obtaining directly nota_teorpro and nota_lab of said examination (CG3, CG4, CG6, CE1).

For the second call, the student will always be evaluated by the final exam modality.

SUBJECT EVALUATION.

Regardless of the evaluation modality chosen, a minimum of 5 will be required to pass both in theory-problems (nota_teorpro) and in laboratory (nota_lab). In that case, the final grade of the subject will be obtained as follows:

Grade = (2*nota_teorpro + nota_lab)/3

Otherwise: Grade = min(nota_teorpro, nota_lab)

If the subject is not passed but the part of the laboratory is passed, the note corresponding to this part is kept for the next year.

In any case, the evaluation system will be governed by the provisions of the Regulation of Evaluation and Qualification of the Universitat de València for Degrees and Masters (https://webges.uv.es/uvTaeWeb/MuestraInformacionEdictoPublicoFrontAction.do?accion=inicio&idEdictoSeleccionado=5639)

REFERENCES

Basic

- J. Fraile Mora. Máquinas Eléctricas. McGraw-Hill, ebook ISBN 9788448180072
- Chapman, S. J. Máquinas Electricas. Cuarta Edición. McGraw-Hill, 2007
- J. Sanz Feito. Máquinas Eléctricas Prentice Hall, Madrid 2004
- Transformadores de potencia, de medida y de protección, Marcombo 1988