Universidad Zaragoza

Year : 2019/20

30116 - Basic principles of electrical technology

Syllabus Information

Academic Year: 2019/20
Subject: 30116 - Basic principles of electrical technology
Faculty / School: 175 - Escuela Universitaria Politécnica de La Almunia
179 - Centro Universitario de la Defensa - Zaragoza
Degree: 457 - Bachelor's Degree in Industrial Organisational Engineering
563 - Bachelor's Degree in Industrial Organisational Engineering
425 - Bachelor's Degree in Industrial Organisational Engineering
ECTS: 6.0
Year: 2
Semester: Second semester
Subject Type: Compulsory
Module: ---

1.General information

1.1.Aims of the course

The subject and its expected results respond to the following approaches and objectives:

This subject belongs to the common training module to address the knowledge and use of the principles of circuit theory and electrical machines.

1.2.Context and importance of this course in the degree

The subject of Fundamentals of Electrotechnics, is part of the Degree in Engineering of Industrial Organization taught by the University of Zaragoza, framed within the group of subjects that make up the module called Common Training and within this to the subject Fundamentals of Electrotechnics. It is a subject of the second year of compulsory education (OB), with a teaching load of 6 ECTS credits.

It is understood that the student accesses this subject with previous knowledge acquired in previous courses, which serve as the basis, being able to quote those related to the theory of electric and magnetic fields, mathematics, chemistry, technical drawing, etc.

This course serves as the basis for the Fundamentals of Electronics subject taught in the 3rd year of the degree.

On the other hand, this subject implies a more than discrete impact in the acquisition of the skills of the degree, and provides useful training in the performance of the functions of the Industrial Organization Engineer related to the field of electricity.

1.3.Recommendations to take this course

The development of the Fundamentals of Electrotechnics course requires putting into play knowledge and strategies acquired in subjects such as:

- **Technical drawing:** Graphic resources and expression techniques are an essential tool to express technical ideas. The views, plans and circuit diagrams are documents commonly used in Electrical engineering.

- **Physics:** Knowledge of the principles and laws of electromagnetism allows understanding the operation of the elements, devices and systems that are the subject of study in Electrical Engineering.

- C**hemistry:** Knowing the structure of matter and some chemical phenomena, helps advance the study of Electrical Engineering

- **Mathematics:** Theorems, algorithms and strategies learned in this discipline, are of essential use in the approach and resolution of all calculations that are carried out in Electrical engineering.

In relation to the above, in the first three semesters of the degree courses are taken related to these subjects, providing the basic knowledge to be able to follow, without any kind of problem, Fundamentals of Electrotechnics. It is advisable to have studied the subjects related to the above-mentioned subjects before taking the Fundamentals of Electrotechnics.

2.Learning goals

2.1.Competences

Upon passing the subject, the student will be more competent to ...

- Ability to solve problems and take decisions with initiative, creativity and critical reasoning.
- Ability to communicate knowledge and skills in Spanish.
- Knowledge and utilisation of the theoretical principles of circuits and electrical machinery.

2.2.Learning goals

The student, to pass this subject, must demonstrate the following results ...

- Defines the fundamentals of the theory of circuits and electrical machines
- It analyzes the principles of circuit theory and electrical machines and has the ability to apply them to the analysis of simple problems of electrical circuits and electrical machines.

2.3.Importance of learning goals

Through the achievement of the relevant learning outcomes of this subject the student will acquire the necessary capacity to understand the operation of circuits, installations and electrical machines, for the management of basic electrical instrumentation, as well as for the use of terminology. electrical engineering. On the other hand, the student will obtain the ability to evaluate and prevent the risks, both their own and those of their dependents, when working with electrical installations.

This subject, which has a marked engineering character, provides the necessary foundations for the development of future subjects taught in the degree such as Fundamentals of Electronics and others included in the optional modules, as well as offering training with application contents and immediate development in the labor and professional market. The competences acquired through it are essential for the design and implementation of any application, plant, process, etc. included within the scope of Industrial Organization Engineering.

3.Assessment (1st and 2nd call)

3.1.Assessment tasks (description of tasks, marking system and assessment criteria)

Profile defense

The student must demonstrate that he has achieved the anticipated **learning results** through the following **evaluation options**:

OPTION 1

It consists of:

Evaluable activities throughout the course (30%)

In order to encourage the continued work of the student, evaluable activities distributed throughout the semester will be carried out. These activities will consist of:

- **Deliverable exercises** to solve in personal work hours. The statement will be made available to the student through Moodle. They must be resolved (also through Moodle) within a maximum period of one week after their order and the resolution will be individual. To be able to access the option 1 for the evaluation of the subject, all the proposed deliverable exercises must be solved in time and obtain a minimum total score of 5 points out of 10. The total note of the deliverable exercises does not compute in the final grade of the subject.
- **Written short tests** distributed throughout the semester. These tests will be solved individually, they will be held during class time, they will have an estimated duration of 30 minutes and will consist of solving a series of theoretical-practical exercises. To qualify for option 1 evaluation must obtain a minimum total score in short tests of 5 out of 10. The short test score will be 30% of the final grade of the subject.

Laboratory practices (10%)

The previous preparation of each practice, the development of each laboratory session and the results obtained in each of them will be valued.

- The evaluation of the development of each laboratory session will be carried out assessing the **strict compliance with the general safety standards** of the laboratory and individuals of each practice, as well as the proper and

correct use of the equipment and materials of the laboratory. The work developed in the laboratory and the attitude shown throughout the development of each practice will be valued .

- The results obtained in each practice will be evaluated through the results sheet that is at the end of each practice script. Said results sheet will be filled in, jointly, by all the members of each group of practices, and will be delivered at the end of each session.

The total qualification of the practices will suppose a 10% of the final note of the subject. To qualify for option 1 of evaluation, you must attend **all practice sessions** and obtain a **minimum total score** of 5 points out of 10 practices.

Final exam (60%)

It will consist of a written test that will contain theoretical-practical issues and problems. During this test, books, notes or any other type of documentation can not be used.

The exam grade will represent 60% of the final grade for the subject. To be eligible for option 1 of evaluation, it will be necessary to obtain a **minimum score of 3.5 points** out of 10 in the part of the exam corresponding to issues and a **minimum score of 3.5 points** out of 10 in the part corresponding to problems.

To pass the subject according to this option 1, **ALL** the indicated minimum conditions must be met and obtain a Final Note (calculated as indicated: 30% total total evaluable activities + 10% total laboratory practical note + 60% total final exam) e **qual or greater than 5 points out of 10**.

OPTION 2

It will be applied to those students who do not follow, or who have not reached **ALL** the minimum required to apply the evaluation indicated in option 1.

It consists of:

Evaluation of practices (20%)

At the end of the semester, a practical test will be carried out in the laboratory (*) during which the student must demonstrate that he is able to perform correctly, **without documentary suppor**t, a certain number of sections contained in the practice scripts. This exam will be **individual**.

The qualification of this exam will suppose a 20% of the total note of the subject. To pass the subject you must obtain a **minimum score** of 5 points out of 10 in this practical exam.

(*) Those students who have attended **all laboratory sessions** and have obtained in them a total score **equal to or greater than 5/10 points**, will be exempt from taking the practice exam.

Final exam (80%)

It will consist of a written test that will contain theoretical-practical issues and problems. During this test, books, notes or any other type of documentation can not be used.

The qualification of this exam will represent 80% of the total mark of the subject. To pass the subject you must obtain a **minimum score in the final exam** of 5 points out of 10.

Observations :

- In the 2nd call of the subject, **Option 2** of the evaluation will be applied to **all students**.
- In case of not fulfilling any of the minimum conditions required to pass the subject, the **Final Note** of the subject will be the grade obtained in the final exam (**Final Note = 100% total final exam**).

4.Methodology, learning tasks, syllabus and resources

4.1.Methodological overview

The learning process designed for this subject is based on the following:

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Strong interaction between the teacher/student. This interaction is brought into being through a division of work and responsibilities between the students and the teacher. Nevertheless, it must be taken into account that, to a certain degree, students can set their learning pace based on their own needs and availability, following the guidelines set by the teacher.

The current subject fundamentals of Electrotechnics are conceived as a stand-alone combination of contents, yet organized into three fundamental and complementary forms, which are: the theoretical concepts of each teaching unit, the solving of problems or resolution of questions and laboratory work, at the same time supported by other activities.

The organization of teaching will be carried out using the following steps:

- **Theory Classes**: Theoretical activities carried out mainly through exposition by the teacher, where the theoretical supports of the subject are displayed, highlighting the fundamental, structuring them in topics and or sections, interrelating them.

- **Practical Classes**: The teacher resolves practical problems or cases for demonstrative purposes. This type of teaching complements the theory shown in the lectures with practical aspects.
- **Laboratory Workshop**: The lecture group is divided up into various groups, according to the number of registered students, in order to make up smaller sized groups.
- **Group Tutorials**: Programmed activities of learning follow-up in which the teacher meets with a group of students to guide their work of autonomous learning and supervision of works directed or requiring a very high degree of advice by the teacher.
- **Individual Tutorials**: Those carried out giving individual, personalized attention with a teacher from the department. Said tutorials may be in person or online.

Defence profile

Ongoing study and effort are essential to achieve the learning outcomes of this course.

The methodology is based on lectures, practical classes with student participation, laboratory sessions. Some individual graded assignments are issued throughout the semester, such as homework, quizzes, and other activities, trying to encourage the continued work of students.

4.2.Learning tasks

The program offered to the student to help them achieve their target results is made up of the following activities...

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Involves the active participation of the student, in a way that the results achieved in the learning process are developed, not taking away from those already set out, the activities are the following:

- Face-to-face generic activities:

Lectures: The theoretical concepts of the subject are explained and illustrative examples are developed as a support to the theory when necessary.

Practice Sessions: Problems and practical cases are carried out, complementary to the theoretical concepts studied.

Laboratory Workshop: This work is tutored by a teacher, in groups of no more than 20 students.

- Generic non-class activities:

Study and understanding of the theory taught in the lectures.

Understanding and assimilation of the problems and practical cases solved in the practical classes.

Preparation of seminars, solutions to proposed problems, etc.

Preparation of laboratory workshops, preparation of summaries and reports.

Preparation of the written tests for continuous assessment and final exams.

- Tutored autonomous activities.

Although they will have more of a face character have been taken into account in part for their idiosyncrasies, they will be primarily focused on seminars and tutorials under the supervision of the teacher.

- Reinforcement activities.

Non-contact marking character, through a virtual learning portal (Moodle) various activities that reinforce the basic contents of the subject be addressed. These activities can be customized or not, controlling their realization through it.

Defense profile

- Lectures: The topics addressed are the fundamental principles of electrical circuits, the operating principles of their elements, techniques and procedures for circuit analysis and study, and the operating principles of the most common electrical machines, as well as basic selection criteria. Student participation is encouraged.
- Problem classes: In order to illustrate the application of different procedures and techniques presented during the lectures, several problem cases are solved with the active collaboration of students.
- Laboratory sessions: With the aim of achieving meaningful learning, many of the concepts presented in the lecture sessions are applied in the laboratory. Many working techniques on electrical circuits are exercised in the laboratory, students acquire skills in the use of electrical measuring devices and they also acquire the awareness of electrical hazards, being able to implement basic actions to avoid unsafe work conditions.
- Evaluable Activities: There are two types:
    - Some consist of the resolution by the students, in their study time, of different exercises proposed by the teacher. The correction and marking of these exercises provide information to students about the work that has developed.
    - The second type of assessment activities involves the resolution of brief questionnaires, for a certain time of a lecture session, that require the direct application of concepts to be seen throughout the semester.

4.3.Syllabus

The course is articulated based on eight teaching units attached relationship, indivisible blocks of treatment, given the

configuration of the subject that program. These topics collect the contents needed for the acquisition of predetermined learning outcomes.

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- TOPIC 1: Basic electrical concepts.
- TOPIC 2: Direct current.
- TOPIC 3: Single Phase sinusoidal alternating current.
- TOPIC 4: Three-phase sinusoidal alternating current.
- TOPIC 5: Single-phase transformers.
- TOPIC 6: Three-phase transformers.
- TOPIC 7: Direct current motors.
- TOPIC 8: Three-phase asynchronous motors.

PRACTICAL CONTENTS.

Those workshops to be developed in the laboratory, which will be performed by students in sessions of one hour below.

- WORKSHOP 1: Measurement Resistance.
- WORKSHOP 2: Measurement capabilities.
- WORKSHOP 3: Measurement inductances.
- WORKSHOP 4: Electrical measurements in sinusoidal steady series RLC circuit.
- WORKSHOP 5: Measure Direct current power.
- WORKSHOP 6: Power measurement and power factor correction in a single-phase system

Defence profile

Syllabus:

Topic 1: Kirchhoff's Laws.
1.1. Introduction.
1.2. Units.
1.3. Definitions.
1.4. References' polarity.
1.5. Kirchhoff's laws.

Topic 2: Elements of circuits.
2.1. Ideal elements of circuits.
  2.1.1. Dipoles.
  2.1.2. Quadripoles.
2.2. Real elements of circuits.

Topic 3: Power and energy.
3.1. Definitions.
3.2. Energy and power in dipoles.
3.3. Energy and power in quadripoles.

Topic 4: Circuit analysis methods.
4.1. Introduction.
4.2. Operational impedances and admittances.
4.3. Operational impedances and admittances association. Voltage divider and current divider.
4.4. Circuit representations.
4.5. Branch transformations.
4.6. Real source transformations.
4.7. Network circuit analysis methods.
  4.7.1. Nodal analysis method.
  4.7.2. Mesh analysis method.

Topic 5: Fundamental theorems.
5.1. Introduction.
5.2. Superposition theorem.
5.3. Thevenin's theorem.
5.4. Norton's theorem.

Topic 6: Sinusoidal steady state electric circuit analysis.
6.1. Introduction.
6.2. Sinusoidal voltage generation.
6.3. Sinusoidal waveforms. Properties.
6.4. Circuits supplied with sinusoidal sources.
6.5. Determination of the sinusoidal steady state.
6.6. Complex impedances and admittances. Complex impedances association.
6.7. Passive components in sinusoidal steady state.
6.8. Kirchhoff's Laws in sinusoidal steady state.
6.9. Methods of circuit analysis in sinusoidal steady state.
6.10. Fundamental theorems in sinusoidal steady state.
6.11. Basic circuits in sinusoidal steady state.

Topic 7: Power in sinusoidal steady state circuits.
7.1. Instantaneous power.
7.2. Instantaneous power in basic passive dipoles.

7.3. Power in sinusoidal steady state. Power triangle.
7.4. Complex power in passive dipoles.
7.5. Power factor.
7.6. Theorems related to power in sinusoidal steady state.
7.7. Power measurement.

Topic 8: Balanced three-phase systems.
8.1. Introduction.
8.2. Generating a three-phase system.
8.3. Wye and delta connections.
8.4. Three-phase systems schemes.
8.5. Voltages and currents in three-phase systems.
8.6. Balanced three-phase systems.

Topic 9: Fundamentals of electric machines. Selection and application.
9.1. Introduction: definition and classification.
9.2. General constitution of a transformer.
9.3. Transformers selection.

4.4.Course planning and calendar

The subject has 6 ECTS credits, which represents 150 hours of student work in the subject during the trimester, in other words, 10 hours per week for 15 weeks of class.

A summary of a weekly timetable guide can be seen in the following table. These figures are obtained from the subject file in the Accreditation Report of the degree, taking into account the level of experimentation considered for the said subject is moderate.

Activity	**Weekly school hours**
Lectures	3
Laboratory	1
Others activities	6

Nevertheless, the previous table can be shown in greater detail, taking into account the following overall distribution:

- 45 hours of lectures, with 50% theoretical demonstration and 50% solving type problems.
- 10 hours of laboratory workshop, in 1 or 2-hour sessions.
- 5 hours of written assessment tests, one or two hours per test.
- 90 hours of personal study, divided up over the 15 weeks of the semester.

Written continuous assessment tests are related to the following topics:

- **Written assessment test 1**: Topics 1, 2, 3 y 4.
- **Written assessment test 2**: Topics 5, 6, 7 y 8.

The issues on which the work will be developed will be proposed in the third week, carrying out delivery and exposure before the last two weeks teaching in the course of the signature dates will be specified.

The most significant dates of the continuous evaluation system will be published in Moodle during the development of the course.

The dates of the global evaluation test will be published officially in http://www.eupla.unizar.es/asuntos-academicos/examenes

Defense profile

Lectures and problem classes, and the laboratory sessions are held according to the schedule established by the Centre and available on the website of Centro Universitario de la Defensa (http://cud.unizar.es).

The other activities of the course are announced well in advance through the Moodle platform (http://moodle2.unizar.es).

4.5.Bibliography and recommended resources

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Resources and materials used in the development of the subject are reflected in the following table:

Material	**Format**
Topic theory notes Topic problems	Paper/repository
Topic theory notes Topic presentationso	Digital/Moodle

Topic problems Related links	E-Mail
Software	Pc's laboratorio
Technical manuals	Paper/repository Digital/Moodle
Multimeters ammeters Voltmeters Power Meters Frequency Transformers. Rectifiers Oscilloscopes Single and three phase loads Engines Electrical switchgear	