VNIVERSITAT DE VALÈNCIA

Course Guide
34780 Principles of electrical engineering and electronics

COURSE DATA

Data Subject	
Code	34780
Name	Principles of electrical engineering and electronics
Cycle	Grade
ECTS Credits	6.0
Academic year	2021 - 2022

Study (s)

Degree	Center	Acad. year	Period
1401 - Degree in Chemical Engineering	School of Engineering	2	Second term

Subject-matter

Degree	Subject-matter	Character
1401 - Degree in Chemical Engineering	9 - Foundations of electrotechnics and electronics	Obligatory

Coordination

Name	Department
FERRERES SABATER, AGUSTIN	242 - Electronic Engineering

SUMMARY

This course develops the course "Fundamentals of Electrical and Electronics" for the Chemical Engineering Graduate. The main goals are to introduce the student in the basic principles of circuit theory and the use of the basic tools of circuit analysis, the utilization of the basic equipment of an electronics lab, learn the basic semiconductor devices (diodes and transistors) and their operation, and study the physical principle of some sensors used in the chemical industry and their electronic conditioning, including the analogue to digital and digital to analogue conversion, and finally, to present an introduction to the basic facilities and electrical machines that can be found in any chemical plant.

It is a subject that has a fundamental and, at the same time, technological character and that aims at the students of this degree having basic knowledge in electronics and electrical engineering. For this reason, the two main objectives of the subject are, on the one hand, to provide the student with the basic knowledge of the analysis of electrical circuits (what is called circuit theory) and the measurement of electrical quantities and, on the other hand, of the industrial applications of the most important electrical systems such as sensing elements, electrical machines and semiconductor devices. The objective is ambitious and the contents are developed without going into much depth, but without renouncing the required rigor.

The two main objectives of the course are providing students basic knowledge in electrical circuit analysis (circuit theory) and the knowledge of the main industrial elements: sensors, electrical machines and semiconductor devices.

From these two main objectives, circuit analysis and fundamentals of electronics are the basic tools to cope with the study of any electronic system. At the end of the course, students should be able to handle such tools to solve circuits that include power supplies (voltage and/or current) and passive elements (resistors, inductors and capacitors) and active (diodes and transistors). They must also be able to handle the main equipment of an electronics laboratory.

It also occupies a prominent place in the agenda, the knowledge of the physical principle of operation, its limitations and applications of some sensors used in the chemical industry, as well as the type of electronic conditioning required by these sensors.

The main objectives are summarized below:

- Understand the basic concepts of voltage and current sources, the passive elements (resistors, capacitors and inductors) and their mathematical description the time domain and in steady sinusoidal.
- Assimilation of Kirchhoff's laws (meshes and nodes) and the superposition principle which allows us to decompose a more complex problem of circuit analysis in simpler ones.
- Understand the importance of the Thevenin and Norton theorems, which can reduce a complex electronic system to a "black box".
- Understand the concepts of power, energy and its application in circuit theory.
- Knowing how to use the main equipment of an electronics laboratory: power supply, digital multimeter, function generator and oscilloscope.
- Understand the operation of the diode, bipolar transistor (BJT) and field-effect transistor (FET).
- Show a classification of the different sensors depending on the physical variable being measured.
- Know the physical principle of operation, limitations and applications of some sensors for application in the chemical industry. Specifically, the temperature sensors (RTDs and thermistors) and concentration sensors (pH and photodiodes).
- Know how to design, implement and calibrate basic conditioning circuits for sensors based on a Wheatstone bridge and amplifier operational.
- Know the facilities and three-phase systems and their star and triangle connection.
- Show the general principles of static electrical machines (transformer) and dynamic (synchronous machines, asynchronous and DC).
- Know the facilities and three-phase systems and their star and triangle connection.

The course contents will be developed in the following thematic units:

UT 1: Circuit analysis

UT 2: Semiconductor devices

UT 3: Sensors

UT 4: Conditioning circuits. Applications.

UT 5: Electrical engineering. Electrical Installations and standard loads.

UT 6: Laboratory of Electrical and Electronic Principles

The theory classes will be taught in Spanish (or Valencian if applicable) and the practical and laboratory classes according to the information sheet available on the web of the degree.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

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

Other requirements

As this is a basic subject that is taught in the second year, there are no prerequisites for Electronics or Circuit Theory, although it is convenient for the student to be fluent in some physical concepts such as:

Knowledge of physical concepts associated with signals such as amplitude, period, frequency and angular frequency.
Knowledge of the units associated with the fundamental physical quantities and flow to work with them.
Knowledge of field, force, energy and power concepts.

OUTCOMES

1401 - Degree in Chemical Engineering

- G3 - 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.
- G4 - 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.
- G5 - Knowledge to carry out measurements, calculations, assessments, appraisals, surveys, studies, reports, work plans and analogous work.
- G6 - Ability to deal with specifications, regulations and mandatory standards.
- G11 - Knowledge, understanding and ability to apply the necessary legislation for practising professionally as a qualified industrial technical engineer.
- R4 - Knowledge and use of the fundamentals of circuit theory and electric machines.
- R5 - Knowledge of the fundamentals of electronics.

LEARNING OUTCOMES

The learning outcomes after completing the signature are:

- Calculate the various electrical quantities of a circuit, in steady state. (G4, G5, R4, R5)
- To know and apply the theorems and techniques of analysis of linear circuits of direct and alternating current. (G3, G4, R4, R5)
- Apply mathematical and physical procedures for the analysis of transient phenomena in first and second order circuits. (G3, G4, G5, R4, R5)
- (G6, G11, R4, R5) To know the basic components of electric machines, as well as the different types of machines, their operating principles and their main applications.
- Identify and describe the basic working modes of electronic devices. (G6, G11, R4, R5)

As a result of the acquired learning outcomes, the student will acquire the following skills:

- Calculate the various electrical quantities of a circuit in steady state.
- Know how to analyze electronic circuits using the different circuit analysis tools that are studied in the subject.
- Know how to properly handle the main measurement and test equipment of a laboratory of electronics.
- Know how to assemble and measure simple electronic circuits.
- Identify the different types of semiconductor elements (diode and transistor), their main characteristics and the selection of them depending on the application to which they are intended.
- Know some sensors used in the chemical industry.
- Know how to assemble and verify the operation of some basic conditioning circuits of sensors for the measurement of temperature and concentration.
- Know the functional concepts of industrial and domestic electrical installations.
- To know the functional and constructive characteristics of the electric machines, as well as the different types of machines and their main applications.

DESCRIPTION OF CONTENTS

1. Circuit analysis

Fundamental magnitudes: current, voltage and electrical resistance.
Power supply: voltage and current sources, both in AC and DC. Ohm's Law.
Basic elements: resistors, capacitors and coils. Series and parallel association.
Basic tools of analysis: Kirchhoff's Laws: meshes and nodes. Voltage and current divider. Thévenin and Norton. Superposition theorem.
Frequency response.
AC circuits. Active, reactive and apparent power. Power factor. Efficiency.

2. Semiconductor devices

The PN junction: Types of diodes.
The bipolar transistor: PNP and NPN Unions.
The field-effect transistor.

3. Sensors

Introduction: measurement systems. Sensors
Classification
Temperature sensors (RTD and thermistor).
Concentration sensors (pH and photodiodes).

4. Conditioning circuits. Applications.

Wheatstone Bridge.
Operational amplifier-based circuits.

5. Electrical engineering. Electrical Installations and standard loads.

The electrical network.
Basic concepts of electrical installations.
Basic loads and Electric motors.

6. Laboratory of Electrical and Electronic Principles

Management of the basic equipment: digital multimeter, signal generator and oscilloscope. Measurements of electrical quantities in DC.
Management of the basic equipment: digital multimeter, signal generator and oscilloscope. Measurements of electrical quantities in AC.
Measurement of temperature and their electronic conditioning.
Measurement of humidity
Gas detection and alarm activation.
Electric facility. Power factor correction. Fundamentals of Electric Machines

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	30,00	100
Laboratory practices	20,00	100
Classroom practices	10,00	100
Development of group work	10,00	0
Study and independent work	22,00	0
Readings supplementary material	5,00	0
Preparation of evaluation activities	32,00	0
Preparing lectures	10,00	0
Preparation of practical classes and problem	10,00	0
Resolution of online questionnaires	1,00	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

The development of the course is structured around two themes: learning with the teacher (theory sessions, seminars, workshop problems and tutorials) and laboratory sessions. Students must make individual works (deliverables) through the virtual classroom.

Learning with the teacher (G3, G4, G5, G6, G11, R4, R5)

In the theory sessions the model of master classes with the use of PowerPoint will be used.

In the problem sessions, the professor will explain a number of problems-type corresponding to the different themes of the course. The teacher will advance which day will be devoted to solving problems and what problems will be solved, so that the student can prepare these problems in advance.

Laboratory sessions (G3, G4, G5, G6, G11, R4, R5)

The objectives to be achieved in the laboratory sessions can be summarized as:

- Learning and management of the main equipment that can be found in a basic electronic laboratory.
- Learn to design the conditioning circuit of different sensors.
- Learn how to calibrate an electronic measuring circuit.
- Know the circuits of conditioning of the sensors.
- Know the three phases systems and domestic electrical installations.
- Know the principles of the electric machines.

Lab sessions will be organized around working groups of a maximum of two people.

Tutorials

The students will have a schedule of tutorials whose purpose is to solve problems, doubts, orientation in works, etc. The schedule of these tutorials will be indicated at the beginning of the academic year. They will also have the opportunity to clarify some doubts by email or discussion forums through the use of the tool "Virtual Classroom", provided by the University of Valencia.

In order to successfully complete the teaching methodology described, the student will have the following documents:

- **Teaching Guide**, provides sufficient information to determine what is intended to learn the student, how it will be done, under what conditions and how it will be evaluated.
- **Transparencies** of each of the subjects of the subject.
- **Bulletin of problems** of each one of the subjects of the subject.
- **Script Practice-Preparation and calculations** with the following structure:
  - Goals
  - Material
  - Previous knowledge
  - Theoretical fundament
- **Script of Practices-Experimental procedure**, formed by the following sections:
  - Previous data
  - Goals
  - Activities and experimental procedure

EVALUATION

Modality A:

The evaluation of the learning of the students attending will be of a formative nature and will be carried out through a continuous evaluation of the progress and the work developed throughout the course. This will take into account:

- The resolution of activities (deliverables) that are being proposed for them to work autonomously (multiple response tests, questions, problems Seminars, exhibition of group work, etc...). (G3, G4, G5, G6, G11, R4, R5)
- Evaluation of laboratory practices through the delivery of some reports or questionnaires of the practices. (G3, G4, G5, G6, G11, R4, R5):
- Exam that will consist of multiple-choice questions that will evaluate the theory and laboratory part. On the other hand several practical questions related to problems done in class. (G3, G4, G5, G6, G11, R4, R5).

Laboratory practices are considered non-recoverable activities and the completion of the practices is a necessary condition to pass the subject.

The weighting of the ratings over 100% will be as follows.

- 1.1. Deliverables of theory and problems: 19%
- 1.2. TEST theory and laboratory: 52%
- 1.3. Examination of problems: 12%
- 1.4. Attendance and completion of laboratory practices and the corresponding deliverables: 17%

To be evaluated in this way, it is necessary to attend at least 80% of the laboratory sessions, deliver at least one of the proposed deliverables and obtain a grade greater than or equal to 4 out of 10 in each of the items evaluated: 1.1, 1.2, 1.3, 1.4

Modality B:

It will apply to students who:

- In a justified way, they have not been able to attend at least 80% of the laboratory sessions.
- Those who have not submitted any work.
- Those who have not passed the first call.

There will be a multiple-choice exam with content from all parts of the subject whose weight in the final grade will depend on if the student delivers the works during the continuous assessment. The weight of each part in the final grade of the subject is as follows:

1. Multiple choice exam: 64% if at least one work has been submitted. If no work has been delivered, its weight rises to 83%.
2. Delivered works: 19%. If they did not give up their weight, they pass the multiple-choice exam.
3. Attendance and realization of the laboratory practices with the reports of the practices delivered at the end of the laboratory session. 17%

To pass, it is considered mandatory to obtain a grade greater than or equal to 5 out of 10 in each of the items evaluated: 1 and 3.

The evaluation in second call will only be possible through modality B.

In any case, the evaluation system will be governed by the one established in the Regulation of Evaluation and Qualification of the University of Valencia for Degrees and Masters (http://links.uv.es/7S40pjF).

REFERENCES

Basic

- José Espí López, Gustavo Camps Valls, Jordi Muñoz Marí. "Fundamentos de Electrónica Analógica". Servei de Publicacions de la Universitat de València. Juny, 2006. (ebook en UV)
- Malvino, A.; Bates, D. J. Principios de Electrónica. McGraw-Hill, Séptima edición, 2007. (ebook en UV)

- Tecnología Eléctrica. DAWSONERA ISBN 9788448192983. (ebook en UV)

Additional

- V. Esteve, J. Jordán. Equipos Electrónicos. Ed. Moliner
- José Espí López, Gustavo Camps Valls, Jordi Muñoz Marí. "Electrónica Analógica. Problemas y Cuestiones" Prentice-Hall/Pearson Educación
- Problemas de Tecnología eléctrica - Roger Folch, José, Riera Guasp, Martín, Roldán Porta, Carlos. Sintesis Editorial. EISBN: 849077580X, 9788490775806 (ebook en UV)

ADDENDUM COVID-19

This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council

Contents

The contents initially established in the Course Guide are maintained.

Workload and planning of teaching

Workload:

The activities described in the Course Guide with their time dedication are maintained.

Planning of teaching:

The resources used in the theoretical and practical sessions allow to continue with the planning of teaching both in days and in scheduled, both of if is in-person class or not.

Teaching methodology

If it is required by the sanitary situation, the Academic Committee of the Degree will approve the Teaching Model of the Degree and its adaption to each subject, establishing the specific conditions in which it will be developed, taking into account the actual enrolment data and the space availability.

If there is a closure of the facilities for sanitary reasons that totally or partially affects the classes, these will be replaced by non-person sessions following the established timetable.

Evaluation

The evaluation system described in the Course Guide in which the activities have been specified as well as their contribution to the final grade of the subject is maintained.

If there is a closure of the facilities for sanitary reasons that affect the development of any face-to-face evaluable activity, it will be replaced by a test/activity of a similar nature that will be carried out in virtual mode using the computer tools licensed by the University of Valencia. The contribution of each evaluable activity to the final grade of the course will remain unchanged, as established in this guide.

References

The recommended references in the Course Guide are maintained, since they are available. In addition, it will be complemented with notes, slides and problems uploaded to the Virtual Classroom.