SUBJECT TEACHING GUIDE

G34 - Basic Experimental Physics IV: Circuits and Electronics

Double Degree in Physics and Mathematics

Double Degree in Physics and Mathematics

Degree in Physics

Degree in Physics

Academic year 2024-2025

1. IDENTIFYING DATA					
Degree	Double Degree in Physics and Mathematics Double Degree in Physics and Mathematics Degree in Physics Degree in Physics			Type and Year	Core. Year 1 Core. Year 1
Faculty	Faculty of Sciences				
Discipline	Subject Area: Basic Experimental Physics Basic Module				
Course unit title and code	G34 - Basic Experimental Physics IV: Circuits and Electronics				
Number of ECTS credits allocated	6	Term		Semester based (2)	
Knowledge Field					
Web	https://moodle.unican.es				
Language of instruction	Spanish	English Friendly	No	Mode of delivery	Face-to-face

Department	DPTO. INGENIERIA DE COMUNICACIONES
Name of lecturer	ALVARO GOMEZ GOMEZ
E-mail	alvaro.gomez@unican.es
Office	Edificio Ing. de Telecomunicación Prof. José Luis García García. Planta: - 2. DESPACHO S276 (S276)
Other lecturers	JUAN ANTONIO SAIZ IPIÑA OSCAR FERNANDEZ FERNANDEZ

4. OBJECTIVES
Know the basic laws of electrostatics, magnetostatics and the phenomenon of electromagnetic induction.
To introduce the student to the modeling of electrical and electronic devices from the concept of localized parameters and to know how to propose the correct approach depending on the needs of each practical situation.
Understand and perfectly handle the fundamental variables of circuit theory and its units.
Apply Kirchhoff's Laws to the resolution of direct current circuits.
Assimilate the concept of power and discern between absorption and dissipation of power by a circuit element.
Simplify linear circuits from their Thévenin or Norton equivalent as seen from two of its terminals.
Introduce the student in the handling of the most common techniques in circuit analysis.
Obtain the evolution in time of voltage and intensity in first-order RC and RL circuits, versus changes in power.
To introduce students to the use of phasor notation in order to apply it to the resolution of alternating current circuits with sinusoidal sources.
Know and learn to handle the basic instrumentation of measurement (voltmeter, ammeter, oscilloscope) and power of circuits (function generators, direct current power supplies) in electricity and electronics.

6. SUBJECT PROGRAM	
CONTENTS	
1	Thematic Block 1: Fundamentals of Electromagnetics
1.1	Lesson 1: The Electric Field and Gauss's Law Charge and electric force. Coulomb's law. Electric field. Electric flux. Gauss's Law. Applications. Lesson 2: Electric potential. Electric potential. Electric potential energy. Electric field from potential. Lesson 3: Electric current. Electric current and current density. Drag velocity. Resistance. Electrical energy and power. Applications. Lesson 4: The magnetic field. Magnetic field. Force exerted by a magnetic field on a particle. Lorentz force. Motion of a charged particle in a uniform magnetic field. Force exerted on a current conductor. Lesson 5: Magnetic field sources. Magnetic field sources. Magnetic field created by a magnet. Ampère's law. Magnetic field created by an electromagnet. Magnetic flux. Lesson 6: Electromagnetic induction. Time-varying magnetic field and flux. Faraday's and Lenz's laws. Electromotive force. Self-induction and mutual induction. Applications.
2	Thematic Block 2: Variables and Electric Circuits Components
2.1	Lesson 7: Variables in electrical circuits Electrical circuits: concepts and types. Electrical circuit variables. Electrical signals. Lesson 8: Circuit components. Modelling of real components by means of ideal elements. Resistors. Independent sources. Capacitors Energy stored by a capacitor Self-inductors energy stored by a self-inductor Diodes Transistors Dependent sources. Lesson 9: Analysis of direct current circuits. Fundamental laws. Constraints imposed by connections Nodes, branches and closed loops. Series and parallel connection. Association of resistors, capacitors and self-inductors. Basic circuit analysis Systematic circuit analysis: knot and mesh technique. Lesson 10: Fundamental circuit theorems. Linear circuits. Superposition method. Equivalent circuits. Thévenin and Norton equivalents. Maximum power transfer.
3	Thematic Block 3: Analysis of Time-Varying Circuits
3.1	Lesson 11: Transient analysis of first and second order circuits. Transient in RC circuits without sources. Transient in RL circuits without sources. Step response of first order circuits. Transient in RLC circuits without sources. Lesson 12: Analysis of circuits in permanent sinusoidal regime. Sinusoidal source. Sinusoidal response. Phasors. Phasor relationships for R, L and C. Impedance and admittance. Phasor analysis of circuits Complex power Conjugate matching

4	Thematic Block 4: Electronic Components
4.1	Lesson 13: Semiconductor materials. Metals, insulators and semiconductors. Classification of semiconductors. Currents in semiconductors. Lesson 14: Semiconductor devices. PN junction. Diodes: types. Circuits with diodes. Bipolar and FET transistors.
5	SIMULATION PRACTICES (PS). Introduction to the use of the NI Multisim circuit simulator to solve electrical and/or electronic circuits. A total of 5 practicals will be carried out. Grouping: individual.
6	BASIC ELECTRONIC PRACTICES (PEB). Introduction to the use of basic measuring instrumentation (multimeter and oscilloscope) and power supply (DC power supply and function generator) for electrical and/or electronic circuits typical of electrical and/or electronic laboratories. A total of 6 practicals will be carried out. Grouping: in pairs or individually.

7. ASSESSMENT METHODS AND CRITERIA

Description	Type	Final Eval.	Reassessn	%
Questions and / or problems relating to Theme blocks 1 and 2	Written exam	No	Yes	32,50
Questions and / or problems relating to Theme blocks 3, 4 and 5	Written exam	No	Yes	32,50
Laboratory Practices	Laboratory evaluation	No	Yes	35,00
Final Exam	Written exam	Yes	Yes	0,00
Extraordinary Exam	Written exam	Yes	No	0,00
TOTAL				100,00

Observations

- In order to pass the subject in continuous assessment or in the ordinary period, it will be necessary, on the one hand, (i) that the weighted average of the marks of the 2 written exams (assessments of Thematic Blocks 1-5) is equal to or higher than 5 and, on the other hand, (ii) that the mark corresponding to the laboratory practicals is equal to or higher than 5.
- In the final exam, the student may choose to improve the grade of (i) the partial evaluations that he/she considers appropriate so that the weighted average of the written exams is equal to or higher than 5 and/or (ii) to take a written exam on the subject of laboratory methods and techniques developed throughout the laboratory practicals so that the grade of the laboratory practicals is equal to or higher than 5. In this case, the final grade of the subject will correspond to the grade obtained in the final exam.
- In the extraordinary assessment, the student will be examined on the whole subject. In this case, in order to pass the subject, the minimum grade required in each of the tests (theory exam and written exam on the laboratory practicals) is 5.

* The exams will be taken without notes or books.

Observations for part-time students

- Part-time students are obliged to attend and complete the practicals. As far as possible, and in agreement with the lecturer, an attempt will be made to make it easier to follow the rest of the course.
- Part-time students must take the assessment tests at the end of the term and, where appropriate, the special exam, which will make up 65% of the total mark. On the other hand, those students who cannot attend and carry out the laboratory practicals throughout the course, must take the exam corresponding to the laboratory practicals, which constitutes 35% of the Total Grade.

8. BIBLIOGRAPHY AND TEACHING MATERIALS
BASIC
Tipler - Mosca, "Física para la Ciencia y la Tecnología", 6ª Edición, Vol.1 y 2 . Ed. Reverté, 2010.
Alexander - Sadiku, “Fundamentos de Circuitos Eléctricos”. 3ª Edición en español. McGraw-Hill, 2013.
P. Gómez Vilda, V. N. Nieto ... , "Fundamentos Físicos y Tecnológicos de la Informática". Pearson - Prentice Hall, 2007.