COMILLAS
UNIVERSIDAD PONTIFICIA
ICAI ICADE CIHS

Syllabus
2023 - 2024

TECHNICAL SHEET OF THE SUBJECT

Data of the subject	
Subject name	Electrical circuits
Subject code	DIE-GITT-120
Mainprogram	Bachelor's Degree in Engineering in Telecommunication Technologies
Level	Reglada Grado Europeo
Quarter	Semestral
Credits	6,0 ECTS
Type	Obligatoria (Grado)
Department	Department of Electrical Engineering
Coordinator	Juan Carlos Maroto Carro
Office hours	A acordar con profesores

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SPECIFIC DATA OF THE SUBJECT

Contextualization of the subject

Contribution to the professional profile of the degree

Introductory course to the analysis and design of simple electrical circuits. We will emphasize useful techniques for the design of electronic circuits. The general objectives of the course are:

- Know the physical foundations of electric current, potential difference and electromotive force.
- Understand the basic mechanisms of electrical conduction and the origin of electrical resistance.
- Use the principle of superposition to analyze simple circuits.
- Understand the Thévenin equivalent circuit to model a linear device using its voltage-current characteristic.
- Familiarize yourself with the spectral representation of electrical signals.
- Know the analysis techniques of resistive circuits and circuits with elements that store energy.
- Become familiar with basic instruments and measurement techniques in a laboratory using simple circuits.

Competencies - Objectives

Competences

GENERALES	
CG03	Conocimiento de materias básicas y tecnologías, que le capacite para el aprendizaje de nuevos métodos y tecnologías, así como que le dote de una gran versatilidad para adaptarse a nuevas situaciones.
CG04	Capacidad de resolver problemas con iniciativa, toma de decisiones, creatividad, y de comunicar y transmitir conocimientos, habilidades y destrezas, comprendiendo la responsabilidad ética y profesional de la actividad del ingeniero técnico de telecomunicación.
ESPECÍFICAS	
CFBT04	Comprensión y dominio de los conceptos básicos de sistemas lineales y las funciones y transformadas relacionadas, teoría de circuitos eléctricos, circuitos electrónicos, principio físico de los semiconductores y familias lógicas, dispositivos electrónicos y fotónicos, tecnología de materiales y su aplicación para la resolución de problemas propios de la

	ingeniería.

Learning outcomes	
RA1	Conocer los fundamentos físicos de la corriente eléctrica, la diferencia de potencial y la fuerza electromotriz.
RA2	Comprender los mecanismos básicos de la conducción eléctrica y el origen de la resistencia eléctrica
RA3	Usar el principio de superposición para analizar circuitos sencillos
RA4	Comprender el circuito equivalente de Thévenin para modelar un dispositivo lineal usando su característica tensión-corriente.
RA5	Familiarizarse con la representación espectral de las señales eléctricas
RA6	Conocer las técnicas de análisis de los circuitos resistivos y de los circuitos con elementos que almacenan energía.
RA7	Familiarizarse con los instrumentos básicos y las técnicas de medida en un laboratorio usando circuitos sencillos.

THEMATIC BLOCKS AND CONTENTS

Contents - Thematic Blocks

Teory

UNIT 1. INTRODUCTORY CONCEPTS

Electrical charges. Forces between charges.

Potential difference.

Current and current density. Current as flow of electrical charges. Current density.

Resistance, resistivity and conductivity.

Ohm's law. Relationship between current and potential difference across a resistor.

Kirchhoff rules.

Basic circuit calculations.

ideal sources. Voltage and current sources.

Electromotive force. Sources of electromotive force. Equivalence between an electrical circuit and a mechanical one.

Energy transfers in a circuit. Power supplied by a voltage source. Power dissipated in a resistor.

UNIT 2. RESISTIVE CIRCUITS

Equivalent resistance Linear circuits. Overlap

Thevenin and Norton circuits. Circuit reduction.

Analysis techniques. Introduction to the analysis of circuits by the method of nodes.

Active circuits. Dependent sources. Analysis of circuits with dependent sources.

UNIT 3. CIRCUITS WITH ELEMENTS THAT STORE ENERGY

Elements that store energy. Inductance and capacity. Characteristic v−i of capacitors and coils. Energy and power.

First order circuit analysis. Step response.

UNIT 4. CIRCUITS IN ALTERNATING CURRENT

Sinusoidal signals. Characteristics and spectral representation.

Periodic signals. Average value and power of a periodic signal. Fourier series.

Capacitors and alternating coils. Impedances. Kirchhoff's laws. Thevenin and Norton dipoles in alternating

First order circuit analysis. Sinusoidal response. Introduction to filtering

Laboratory

Practical 1: Introduction to the Laboratory

1.1 Safety Standards in Electrical Laboratories

1.2 Organization of work in the Laboratory

1.3 Knowledge of the Laboratory

1.4 Measurement of voltages and currents

Practical 2: Laws of Circuits

2.1 Series circuit

2.2 Parallel circuit

Practical 3: Theorems of Thévenin and Norton

3.1 Experimental determination of the values of a circuit

3.2 Thevenin equivalence

3.3 Norton Equivalence

Practical 4: Superposition Theorems

4.1 Superposition Theorem I

4.2 Superposition Theorem II

Practical 5: Charge and discharge process of a capacitor

5.1 Knowledge of the oscilloscope

5.2 Charge and discharge process of a capacitor

TEACHING METHODOLOGY

General methodological aspects of the subject

In-class Methodology: Activities

1. **Presentation of basic concepts**. The teacher introduces a basic concept or application in a maximum time of 10 minutes.
2. **Class problems**. Students spend several minutes trying to understand and doing the assigned problem that deals with the concept explained by the teacher. Finally, the professor discusses his solution, without fully solving it. This activity will take about 15 minutes.
3. **Review of previous problems**. Discussion of class problems from the previous day.
4. **Laboratory practicals.** They will be carried out in groups of approximately three students and in them the students will apply the concepts and techniques studied, becoming familiar with the material and human environment of work in the laboratory.

Non-Presential Methodology: Activities

1. Review class concepts by finishing class problems, which will force you to review the concepts presented by the teacher.
2. Homework. Each week two or three problems will be assigned to be discussed in class the following week. These problems present questions related to the concepts studied in class. Likewise, the solution of the task will be posted on the web page of the subject.
3. Preparation of the laboratory practicals, carrying out the previous calculations required in the script of each practical, first individually and later comparing the results with the rest of the laboratory group.
4. Elaboration of laboratory reports in which what has been done in each practice is exposed, indicating the measurements obtained and the results achieved and analyzing these by exercising critical thinking.

SUMMARY STUDENT WORKING HOURS

CLASSROOM HOURS		
Clase magistral y presentaciones generales	Resolución de problemas de carácter práctico o aplicado	Prácticas de laboratorio, preparación y trabajo posterior
27.00	22.00	11.00
NON-PRESENTIAL HOURS		
Prácticas de laboratorio, preparación y trabajo posterior	Estudio de conceptos teóricos fuera del horario de clase por parte del alumno	
12.00	108.00	
ECTS CREDITS: 6,0 (180,00 hours)		

EVALUATION AND CRITERIA

Evaluation activities	Evaluation criteria	Weight
Partial exam #1 (C1)	• Understanding of concepts. • Application of concepts to the resolution of practical problems. • Analysis and interpretation of the results	15

	obtained in the resolution of problems. • Presentation and written communication.	
Midterm exam (EI) Final exam	• Understanding of concepts. • Application of concepts to the resolution of practical problems. • Analysis and interpretation of the results obtained in the resolution of problems. • Presentation and written communication.	65
• Laboratory Work • Laboratory Exam	To pass this subject, it will be necessary to have passed both the theoretical part and the laboratory independently. The laboratory note is obtained with the preparation of the laboratory (15%), the dedication in the laboratory (15%), the report of the lab practicals (30%) and the laboratory exam (40%). **Previous study. Preparation of practicals**. At the beginning of each laboratory session, each student must have prepared the planning of the work to be done. We advise writing down this work in the LABORATORY NOTEBOOK. Since part of the purpose of the lab is to experiment with a simple circuit, we do not intend this to be a detailed work plan, but it should include what we intend to do, as well as simple calculations to justify our plans. In addition, in the laboratory notebook we will write down the measurements carried out, the faults detected and the conclusions that we draw from our work. All this information will be very useful when we have to prepare for the laboratory test. **Dedication in the laboratory**. The work in the laboratory must be dynamic. We do not come to carry out systematic measurements or monotonous tasks: we come to the laboratory to learn by experimenting with electronic circuits. And have a good time. **Practical report**. Once the practical is over, each group will prepare a report on it. This report will be delivered on the Friday following the practice, in theory class. The final laboratory grade will take into account the quality of this report, but not the amount of paper used in its preparation. Presentation and written communication.	20

Ratings

Ordinary (normal) period

The exams are cumulative and will be taken without books, notes, or programmable calculators, on the following dates:

• Partial exam #1 around week 4: 15% of the final grade.

• Midterm exam towards week 7, 8: 25% of the final grade.

• Final exam: 40% of the final grade.

• Laboratory: 20% of the final grade.

To apply the average mark of the evaluation tests, it will be necessary to have a minimum mark in the final exam of 3.75/10. To pass the subject, the theory and the laboratory must be passed independently. The minimum mark in each part (theory and laboratory) must be better than 5/10. Otherwise, the course mark will be the lower of both.

Failure to attend more than 15% of the classes may cause the loss of the right to take the ordinary call exam (and even the extraordinary call) of the subject (article 93.3 of the General Regulations, and articles 7.2 and 7.3 of the Academic Norms)

Extraordinary (re-sit) exam

• Partial exam #1: 7.5% of the final grade.

• Midterm exam: 12.5% of the final grade.

• Final exam: 60% of the final grade.

• Laboratory: 20% of the final grade. A new laboratory exam will be carried out if the laboratory had been suspended in an ordinary call. In addition, the completion of the report(s) that have not been presented in the ordinary call and a proof of authorship may be requested. Failure to attend the laboratory in the scheduled sessions throughout the semester, in the percentage set according to the School's Regulations, will mean the impossibility of passing in an extraordinary call.

To apply the average mark of the evaluation tests, it will be necessary to have a minimum mark in the final exam of 3.75/10. To pass the subject, the theory and the laboratory must be passed independently. The minimum mark in each part (theory and laboratory) must be better than 5/10. Otherwise, the course mark will be the lower of both.

Failure to attend more than 15% of the classes may cause the loss of the right to take the ordinary call exam (and even the extraordinary call) of the subject (article 93.3 of the General Regulations, and articles 7.2 and 7.3 of the Academic Norms)

WORK PLAN AND SCHEDULE

Activities	Date of realization	Delivery date
Véase cuadro adjunto al final del documento		

BIBLIOGRAPHY AND RESOURCES

Basic Bibliography

- J.W. Nilsson, S.A. Riedel. Electric Circuits.(7ª Ed). Pearson Prentice Hall, 2005.
- A.Bruce Carlson, Circuits: Engineering Concepts and Analysis of Linear Electric Circuits, Thomson Learning, 2000.
- Robert L. Boylestad. Introductory Circuit Analysis, Pearson, 2015.

Complementary Bibliography

- A.H.Robbins, W.C.Miller, Circuit Analysis theory and practice, Cengage Learning, 2012
- J.A. Edminister, Mahmood Nahvi. Electric Circuits. McGraw-Hill, 2004.
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