Course guide
330226 - CSL - Linear Circuits and Systems

Last modified: 28/04/2025

Unit in charge: Manresa School of Engineering
Teaching unit: 750 - EMIT - Department of Mining, Industrial and ICT Engineering.

Degree: BACHELOR'S DEGREE IN ICT SYSTEMS ENGINEERING (Syllabus 2010). (Compulsory subject).

Academic year: 2025 **ECTS Credits:** 6.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: M. ROSA GIRALT MAS

Others:

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. An understanding and mastery of the foundations of linear systems and the associated transforms and functions, electrical circuits theory, electronic circuits, the physical principle of semiconductors and logic families, electronic and photonic devices, and their use in solving engineering problems.
2. Ability to specify, analyze, design, implement, evaluate and document analog circuits, using techniques and descriptions in the temporal, frequency and transformed domains of Laplace.
3. Knowledge and ability to use existing tools and instrumentation for the analysis, design, development and verification of electronic, computer and communications systems.
4. Ability to model and simulate systems in the field of the degree and apply the results to problem solving within this field.

Transversal:
5. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.
6. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors.
7. TEAMWORK - Level 2. Contributing to the consolidation of a team by planning targets and working efficiently to favor communication, task assignment and cohesion.

TEACHING METHODOLOGY

The course consists of face-to-face activities consisting of 3 hours per week in class (large group) and 2 hours per fortnight in the laboratory (small group).
The student carries out learning through various mechanisms. In the lectures and participative classes in the classroom the contents of the subject are presented and the interaction between students and teacher is facilitated. Individual / group personal work activities are also proposed that should contribute to the understanding of the subject.
In the classes in the laboratory, the students carry out a preliminary work that helps to put in context the work that is intended to be carried out in the laboratory. The laboratory activity itself is developed in groups of two students and allows experimenting with certain aspects of the subject. The writing of the memory and the interaction with the teacher in the laboratory allows working on the oral and written communication skills.
From time to time, nomenclature is introduced in English to progressively start the student in learning this language.

LEARNING OBJECTIVES OF THE SUBJECT

Upon completion of the Linear Systems and Circuits course, the student:
- You will know and know how to apply the techniques of analysis of analog electronic circuits of moderate complexity in the temporal and frequency domains and interpret them as signal processors.
- You will be able to specify, analyze, design, develop, evaluate and document analog electronic circuits of moderate complexity.
- You will be able to apply the appropriate methods and techniques, as well as use specific instruments, for the development and verification of analog systems.
- You will know the technical-scientific terminology related to analog systems in English.
- Will develop the ability to work in a team.
- Increase your ability to communicate orally and in writing.

STUDY LOAD

Type	Hours	Percentage
Hours small group	15,0	10.00
Hours large group	45,0	30.00
Self study	90,0	60.00

Total learning time: 150 h

CONTENTS

Content title 1: LAPLACE TRANSFORMED CIRCUIT

Description:
1. The Laplace transform.
2. The Laplace transformed circuit.
3. Impedance and admittance.

Related activities:
A1, A2, A3, A4 and A5

Full-or-part-time: 20h
Theory classes: 8h
Laboratory classes: 2h
Self study : 10h

Content title 2: STUDY OF THE DYNAMICS OF LINEAR CIRCUITS

Description:
1. Characterization of the response of linear circuits.
2. The network function.
3. Stability.

Related activities:
A1, A2, A3, A4 and A5

Full-or-part-time: 24h
Theory classes: 7h
Laboratory classes: 2h
Self study : 15h

Title of content 3: CIRCUITS IN SINUSOIDAL STEADY STATE

Description:
1. Step response.
2. Sinusoidal steady state. (SSS).
3. Phasors. Phasor transform circuits.
4. Power in sinusoidal steady state.

Related activities:
A1, A2, A.3, A4 and A5

Full-or-part-time: 40h
Theory classes: 10h
Laboratory classes: 5h
Self study : 25h

Content title 4: FREQUENCY RESPONSE OF LINEAR CIRCUITS

Description:
1. Frequency response.
2. Bode diagrams.
3. Description of signals in the frequency domain. (Fourier series)
4. Signals filtering.

Related activities:
A1, A2, A3, A4 and A5

Full-or-part-time: 43h
Theory classes: 12h
Laboratory classes: 6h
Self study : 25h

Content Title 5: MAGNETIC COUPLING

Description:
1. Biports.
2. The ideal transformer.
3. The perfect transformer.
4. Application to impedance matching.

Related activities:
A1, A2, A4 and A5

Full-or-part-time: 23h
Theory classes: 8h
Self study : 15h

ACTIVITIES

TITLE OF ACTIVITY 1: LECTURES WITH EXERCISES

Description:
Face-to-face sessions focused on understanding the subject content, completing exercises and assigning new exercises that will lead to new content.

Specific objectives:
Upon completion of the Linear Systems and Circuits course, the student will:
- Know how to apply the techniques of analysis of analog electronic circuits of moderate complexity in the temporal and frequency domains and interpret them as signal processors.
- Know the technical-scientific terminology related to analog systems in English.

Material:
Recommended bibliography.
Published teaching material.

Full-or-part-time: 40h
Theory classes: 40h

TITLE OF ACTIVITY 2: STUDY OF CONTENTS

Description:
Independent study consists of studying to understand and solidify knowledge, vocabulary and techniques either individually or in a group.

Specific objectives:
Upon completion of the Linear Systems and Circuits course, the student will:
- Know how to apply the techniques of analysis of analog electronic circuits of moderate complexity in the temporal and frequency domains and interpret them as signal processors.
- Be able to specify, analyze, design, develop, evaluate and document analog electronic circuits of moderate complexity.
- Be able to apply the appropriate methods and techniques, as well as use the specific instruments, for the development and verification of analogue systems.
- Know the technical-scientific terminology related to analog systems in English.
- Develop the ability to work in a team.

Material:
Recommended bibliography.
Published teaching material.

Full-or-part-time: 30h
Self study: 30h

TITLE OF ACTIVITY 3: LABORATORY CLASS

Description:
The sessions will be conducted at the university laboratories. Students must complete a preliminary study beforehand. In the laboratory, the results of this preliminary study are compared and contrasted with the experimental results of the assembly performed. Throughout the lab session, students must explain the differences between the theoretical and experimental results, propose solutions and redesign or propose new experiments, where appropriate.

Specific objectives:
Upon completion of the Linear Systems and Circuits course, the student will:
- Be able to apply the appropriate methods and techniques, as well as use the specific instruments, for the development and verification of analogue systems.
- Develop the ability to work in a team.
- Increase your ability to communicate orally and in writing.

Material:
Practice manual.
Laboratory equipment.
Recommended bibliography.
Published teaching material.

Delivery:
A preliminary study is delivered before entering the laboratory and a report at the end of the session. Both constitute the laboratory evaluation that accounts for 30% of the final evaluation.

Full-or-part-time: 45h
Self study: 30h
Laboratory classes: 15h

TITLE OF ACTIVITY 4: EXERCISES

Description:
Exercises that students must solve individually or in a group and which they must defend individually before the professor in a 10'-15' interview.

Specific objectives:
Upon completion of the Linear Systems and Circuits course, the student will:
- Know how to apply the techniques of analysis of analog electronic circuits of moderate complexity in the temporal and frequency domains and interpret them as signal processors.
- Be able to specify, analyze, design, develop, evaluate and document analog electronic circuits of moderate complexity.
- Develop the ability to work in a team.
- Increase your ability to communicate orally and in writing.

Material:
Recommended bibliography.
Published teaching material.

Delivery:
A folder with the solved exercises that together with the oral defense of the folder contribute 20% of the final evaluation.

Full-or-part-time: 20h
Self study: 20h

TITLE OF ACTIVITY 5: EXAM

Description:
Written exam in which the knowledge acquired up to the time of examination is evaluated. There will be a midterm that students must take individually. At the end of the class, there will be a final exam on the overall knowledge acquired.

Specific objectives:
Upon completion of the Linear Systems and Circuits course, the student:
- Will have synthesized and consolidated the concepts and techniques worked so far.

Material:
Test statements.
The compilation of the entire course.

Delivery:
Exercises of the tests, which will contribute 60% of the final evaluation.

Full-or-part-time: 15h
Self study: 10h
Theory classes: 5h

GRADING SYSTEM

The final mark for the class will be calculated as:
· 25% Lab activities (A3)
. 15% Exercises (A4)
· 20% Control Exam (A5P)
. 40% Final Exam (A5F)
Assessment will be continuous.
Note 1. If the final exam mark is greater (in part or in total) than other aspects assessed, it will substitute the results obtained on other activities during the class.
Note 2. If the marks obtained on individual activities are substantially lower than those obtained on group activities, students may be requested to complete individual activities similar to those completed in group. The marks on these individual activities will replace the group ones.

EXAMINATION RULES.

All activities are compulsory.
If any of the activities of the subject is not carried out, it will be considered a zero.
Carrying out the laboratory activities is a necessary condition to pass the subject.
In the case of laboratory activities for which a previous study has been established, it will be mandatory to submit it before accessing the laboratory.
Those activities that are explicitly declared as individual, whether in person or not, will be carried out without any collaboration from other people.
The dates, formats and other delivery conditions that are established will be mandatory.

BIBLIOGRAPHY

Basic:
- Thomas, Roland E.; Rosa, Albert J.; Toussaint, Gregory J. The analysis and design of linear circuits. 6th ed. Hoboken: John Wiley & Sons, 2009. ISBN 9780470383308.

Complementary:
- Thomas, Roland E. ; Rosa, Albert J. Circuitos y señales: introducción a los circuitos lineales y de acoplamiento. Barcelona: Reverté, 1991. ISBN 8429134581.
- Irwin, J. David. Análisis básico de circuitos en ingeniería [on line]. 6ª ed. México: Limusa Wesley, 2003 [Consultation: 20/06/2024].

Available on: https://search-ebscohost-com.recursos.biblioteca.upc.edu/login.aspx?direct=true&AuthType=ip,uid&db=nlebk&AN=3756176&site=ehost-live&ebv=EB&ppid=pp_C1. ISBN 9681862953.

RESOURCES

Other resources:
- Linear Systems and Circuits Practice Manual.
- Collection of Circuit and Linear Systems problems.