



Universitat de Lleida

# DEGREE CURRICULUM **CIRCUIT THEORY**

Coordination: CLARIA SANCHO, FRANCISCO

Academic year 2019-20

Subject's general information

<b>Subject name</b>	CIRCUIT THEORY			
<b>Code</b>	102128			
<b>Semester</b>	2nd Q(SEMESTER) CONTINUED EVALUATION			
<b>Typology</b>	<b>Degree</b>	<b>Course</b>	<b>Character</b>	<b>Modality</b>
	Not informed	2	COMPULSORY	Attendance-based
	Bachelor's Degree in Automation and Industrial Electronic Engineering	2	COMPULSORY	Attendance-based
<b>Course number of credits (ECTS)</b>	6			
<b>Type of activity, credits, and groups</b>	<b>Activity type</b>	PRAULA		TEORIA
	<b>Number of credits</b>	3		3
	<b>Number of groups</b>	2		1
<b>Coordination</b>	CLARIA SANCHO, FRANCISCO			
<b>Department</b>	COMPUTER SCIENCE AND INDUSTRIAL ENGINEERING			
<b>Teaching load distribution between lectures and independent student work</b>	(40% ) 60 h classroom (60%) 90 h independent work			
<b>Important information on data processing</b>	Consult <a href="#">this link</a> for more information.			
<b>Language</b>	Castellano			
<b>Office and hour of attention</b>	by agreement			

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
CLARIA SANCHO, FRANCISCO	francisco.claria@udl.cat	6	
PALLEJÀ CABRÉ, TOMÀS	tomas.palleja@udl.cat	3	

## Subject's extra information

It is a subject that is offered in the second year, is framed in the field of electrical engineering and belongs to specific technology module. The content of this course provides the basis to contextualize the subjects for electronic and automatic control

This subject aims to familiarize students with the transformation of circuits and systems to the Laplace domain. We study the temporal response of circuits using the Laplace transform, is given notion of transfer function and introduces the concepts of natural and forced response. We also study the frequency response of circuits, and emphasize the concepts of resonance, spectrum, stability and filtering. With these basics, it becomes apparent association of transfer function and system, marking the way for the analysis and design of electronic systems and control.

The analysis of circuits and transformed systems is often, in general, new to the student. For this reason the content of this field requires some time to be assimilated. The daily study is the best guarantee that the concepts are consolidated throughout the course.

You can have specific educational material for the subject in Virtual Campus.

### PRACTICES AT EPS

It is **COMPULSORY** that the students bring the following elements of individual protection (EPI) to the practices at the laboratory.

- Blue laboratory gown from UdL (unisex)
- Protection glasses
- Mechanical protection gloves

They can be purchased through the shop Údels of the UdL:

C/ Jaume II, 67 baixos  
Centre the Cultures i Cooperació Transfronterera

<http://www.publicacions.udl.cat/>

The use of other elements of protection (for example caps, masks, gloves of chemical or electrical risk, etc.) will depend on the type of practice to be done. In that case, the teacher will inform of the necessity of specific EPI.

Not bringing the EPI's described or not fulfilling the norms of general security that are detailed below imply that the student can not access to the laboratories or have to go out of them. The no realisation of the practices for this

reason imply the **consequences in the evaluation** of the subject that are described in this course guide.

## GENERAL NORMS OF SECURITY IN LABORATORY PRACTICES

- Keep the place of realisation of the practices clean and tidy. The table of work has to be free from backpacks, folders, coats...
- No short trousers or short skirts are allowed in the laboratory.
- Closed and covered footwear is compulsory in the laboratory.
- Long hair needs to be tied.
- Keep the laboratory gown laced in order to be protected from spills of chemicals.
- Bangles, pendants or wide sleeves are not allowed as they can be trapped.
- Avoid the use of contact lenses, since the effect of the chemical products is much bigger if they enter between the contact lense and the cornea. Protection over-glasses can be purchased.
- No food or drink is allowed in the laboratory.
- It is forbidden to smoke in the laboratories.
- Wash your hands whenever you have contact with a chemical product and before going out of the laboratory.
- Follow the instructions of the teacher and of the laboratory technicians and ask for any doubt on security.

For further information, you can check the following document of the *Servei de Prevenció de Riscos Laborals de la UdL*: <http://www.spri.udl.cat/alumnes/index.html>

## Learning objectives

### Objectives

- Analyze a circuit using differential equations.
- Know and use the Laplace Transform (LT) to transform circuits and systems.
- Calculate the time response from transformed circuits or systems.
- Understand the concept and get the transfer function of circuits and systems.
- Knowing the meaning of amplitude and phase spectrum of a transfer function.
- Fix the concept of resonance and its spectral and temporary meaning.

## Competences

**Cross-disciplinary competences** approved by the Comissió Plenària dels Graus d'Enginyeria Industrial, Enginyeria Informàtica i Enginyeria de l'Edificació, gathered 16 Juny 2008.

- **EPS1.** Ability to solve problems and develop and defend arguments within their field of study
- **EPS2.** Ability to collect and interpret relevant data within the study area, to make judgments that include reflection on relevant social issues, scientific or ethical
- **EPS6.** Capacity for analysis and synthesis

**Specific competences** that students should acquire, according ORDRE CIN/351/2009, 9 of febrer.

- **GEEIA19.** Applied knowledge of electrical engineering.

## Subject contents

### CHAPTER 1

#### 1.RESISTIVE CIRCUITS. ELEMENTS AND TOOLS

1.1 INTRODUCTION

1.2 ELEMENTS

1.3 KIRCHHOFF'S LAWS. EQUATIONS OF KNOTS AND LOOP

1.4 VOLTAGE-CURRENT CHARACTERISTICS

1.5 SOURCES DEPENDENTS

1.6 THEVENIN AND NORTON THEOREMS

1.7 V-I CHARACTERISTICS AND EQUIVALENT CIRCUITS

1.8 FINAL CONSIDERATIONS

1.9 PROPOSED PROBLEMS

## **CHAPTER 2**

### **2.CIRCUITS WITH RESISTORS INDUCTORS AND CAPACITORS**

2.1 INTRODUCTION

2.2 R-C CIRCUITS

2.3 R-L CIRCUITS

2.4 R-L-C CIRCUITS. ANALYSIS

2.5 PROPOSED PROBLEMS

## **CHAPTER 3**

### **3.SIGNALS AND THEIR CHARACTERISTICS**

3.1 INTRODUCTION

3.2 SIGNALS

3.3 STEP FUNCTION

3.4 RAMP FUNCTION

3.5 RECTANGULAR PULSE FUNCTION

3.6 IMPULSE FUNCTION

3.7 PROPOSED PROBLEMS

## **CHAPTER 4**

### **4. CIRCUITS ANALYSIS IN THE LAPLACE DOMAIN**

4.1 INTRODUCTION

4.2 THE LAPLACE TRANSFORM.

4.3 THE TRANSFORMED CIRCUIT

4.4 CIRCUIT ANALYSIS TECHNIQUES IN THE LAPLACE DOMAIN

4.5 DETERMINATION GENERAL OF THE RESPONSE

4.6 PROPOSED PROBLEMS

## **CHAPTER 5**

### **5. RESPONSE IN TIME OF LINEAR CIRCUITS**

5.1 LAPLACE INVERSE TRANSFORM

5.2 DETERMINATION OF THE RESPONSE TEMPORAL IN LINEAR CIRCUITS

5.3 TRANSFER FUNCTION

5.4 POLES AND ZEROS OF A TRANSFER FUNCTION

5.5 PROPOSED PROBLEMS

## **CHAPTER 6**

### **6. FREQUENCY RESPONSE OF LINEAR CIRCUITS**

6.1 INTRODUCTION

6.2 SPECTRUM

6.3 FREQUENCY RESPONSE OF FIRST ORDER CIRCUITS

6.4 FREQUENCY RESPONSE OF SECOND ORDER CIRCUITS

6.5 FILTERING CONCEPT

6.6 STUDY OF A FILTER

6.7 FREQUENCY ANALYSIS OF A FILTER

6.8 PROPOSED PROBLEMS

## **CHAPTER 7**

### **7. PERMANENT SINUSOIDAL REGIME**

7.1 INTRODUCTION

7.2 EFFECTIVE VALUE. DEFINITION.

7.3 PERMANENT SINUSOIDAL REGIME AND POWER

7.4 PROPOSED PROBLEMS

## **CHAPTER 8**

### **8. TRANSFORMER**

8.1 INTRODUCTION

- 8.2 IDEAL TRANSFORMER
- 8.3 REAL TRANSFORMER
- 8.4 MAXIMUM TRANSFER OF POWER THEOREM
- 8.5 EXERCISE OF APPLICATION
- 8.6 PROPOSED PROBLEMS

## CHAPTER 9

### 9. TWO-PORT NETWORKS

- 9.1. INTRODUCTION
- 9.2. PARAMETERS ADMITTANCE
- 9.3. PARAMETERS IMPEDANCE
- 9.4. PARAMETERS HYBRID
- 9.5. PARAMETERS OF TRANSMISSION
- 9.6. CONVERSION OF PARAMETERS
- 9.7. INTERCONNECTION OF QUADRIPOLES

## Methodology

**Master class:** In the master classes the contents of the subject are presented orally by a professor without the active participation of students.

**Problem-based learning:** Problem-based learning is used as a method of promoting the learning from selected problems of real life.

**Classroom practices:** Let you apply and configure a practical level, the theory of a field of knowledge in a particular context.

## Development plan

Week	Metodologi	Agenda	Classroom	Autonomous work
1-2	Master class Problem-based learning	RESISTIVE CIRCUITS. ELEMENTS AND TOOLS	6	12
3-5	Master class Problem-based learning	CIRCUITS WITH RESISTORS INDUCTORS AND CAPACITORS SIGNALS AND THEIR CHARACTERISTICS	12	18
6	Master class Problem-based learning	CIRCUITS ANALYSIS IN THE LAPLACE DOMAIN	8	6
7-8	Master class Problem-based learning	RESPONSE IN TIME OF LINEAR CIRCUITS	10	12

9-11	Master class Problem-based learning	FREQUENCY RESPONSE OF LINEAR CIRCUITS	12	18
12-14	Master class Problem-based learning	PERMANENT SINUSOIDAL REGIME TRANSFORMER TWO-PORT NETWORKS	12	18

## Evaluation

### Evaluation Method

During the semester, there shall be four assessments in the form of two written tests and two papers that account for the study and the work done in the labs. These documents will have a maximum score of 1 point each and not considered any improvement threshold. The two written tests will be held on dates determined by the EPS for this purpose.

In this course, by its nature, has little sense to evaluate parts of avoiding your stuff previous contents. Thus, each written test will be on all the stuff that has been given so far.

The first written test will have a maximum score of 3 points and be considered approved if the score is greater than or equal to 1.5 points. The second written test will have a maximum score of 5 points and will be considered



approved if the score is greater than or equal to 2.5 points.

As the material is cumulative in each written test, if the second test is passed, then the first test will be compensated if the latter has not been surpassed, with half its maximum score (1.5 points).

-The total score is the sum of the notes of the 4 reviews. (This is the first of the two possible pathways of qualifications that are contemplated).

-If the second written test you get a lower score to 2.5 points, you must use the recovery activity, to be performed on the date set by the EPS. The written test will have a valuation recovery maximum 8 points and be deemed to have been passed if you get a note added to the laboratory practice notes and document preparation practices study is greater than or equal to 5 points. (This is the second pathway)

In addition:

Any person enrolled in this course, which has been submitted to the second written test, whether it was surpassed or not, there may be a recovery test to increase the final grade. If the second test was successful the final qualification will never be lower than it would have obtained for the first approach.

## Bibliography

### Bibliography and resources

#### **Basic Bibliography:**

#### **Análisis de circuitos**

F. Clariá, J.A. Garriga, J. Palacín

Ed. Edicion de la Universitat de Lleida, 1999

#### **Donald E. Scott.**

*Introducción al análisis de circuitos, un enfoque sistemático.*

Ed. Mc. Graw-Hill. 1988.

#### **William H. Hayat Jr., Jack E. Kemmerly.**

*Análisis de circuitos en ingeniería.*

Ed. Mc. Graw-Hill. 1988.

#### **A. Bruce Carlson.**

*Circuitos.*

Ed. Tomson. 2001

## Extended Bibliography:

**Josep A. Edminister, Mahmood Nahvi.**

Schaum. *Circuitos Eléctricos*.

Ed. Mc. Graw-Hill. 1997

**J. D. Irwing.**

*Análisis básico de circuitos en ingeniería.*

Ed. Prentice Hall. 1997

**R. Sanjurjo Navarro, E. Lázaro Sanchez, P.de Miguel Rodríguez.**

Teoría de *circuitos eléctricos*.

Ed. Mc. Graw-Hill. 1997

**James W. Nilsson.**

*Circuitos Eléctricos*.

Ed. Addison Wesley Iberoamericana. 1995

**A. Gómez Expósito, J.A. Olivera Ortiz de Urbina.**

*Problemas resueltos de Teoría de Circuitos.*

Ed. Paraninfo. 1990

**J.M. Miró, A. Puerta, J.M. Miguel, M. Sanz.**

*Análisis y diseño de circuitos con PC.*

Ed. Marcombo. 1989

**Murray R. Spiegel.**

*Transformadas de Laplace.*

Ed. Mc. Graw-Hill. 1985

## **M. Torres.**

*Circuitos integrados lineales.*

Ed. Paraninfo. 1985

## **Gladwyn Lago, Lloyd M. Benningfield.**

*Teoría de sistemas y circuitos.*

Ed. Limusa. 1984

## **J. Herrera.**

*Teoría de Circuitos.*

Ed. Limusa. 1980

## **F. Jimenez.**

*Análisis de Circuitos Eléctricos. Teoría y Problemas.*

Ed. Limusa. 1980

## **M.E. Van Walkenburg.**

*Análisis de Redes.*

Ed. Limusa. 1977

## **Hugh Hildreth Skilling.**

*Circuitos en ingeniería eléctrica.*

*Ed. Compañía editorial continental S.A. 1974*

## **Adaptations to the methodology due to COVID-19**

The current methodology is not modified except that all face-to-face activity is carried out through electronic communications.

The **Master Classes** are conducted online via videoconference and the Classroom Practices are conducted offline using virtual simulation.

**Problem-based learning** is configured as the basic methodology to promote self-learning, based on key problems and exercises that have been provided in addition to the available documentation.

## **Adaptations to the development plan due to COVID-19**

There is no substantial variation in the course development plan.

## Adaptations to the evaluation due to COVID-19

### Assessment of the subject

During the semester 4 evaluations are carried out, always by electronic communications.

Two of the evaluations will come from the two documents that account for the previous study and the work done during the practices carried out using simulation procedures. These documents will have a maximum rating of 2 points each.

The third and fourth evaluation will be based on the resolution of a set of exercises, with a predetermined delivery date, whose statements will be issued after the theoretical matter necessary for its solution has been taught. The third evaluation will have a maximum value of 4 points and the fourth of 2 points.

None of these evaluations has a passing threshold. The total mark will be the sum of the marks of the 4 evaluations.

- The course will be considered approved if the mark is greater than or equal to 5 points. **(This is the first of the two possible qualification pathways contemplated).**

- If a score of less than 5 points is obtained in the sum of the evaluations, use must be made of the recovery activity, to be carried out on a date set by the EPS. The recovery test will be based on the resolution of an exercise, to be delivered at a predetermined time interval and an online interview with the professor through a conference call. This recovery activity will have a maximum rating of 6 points and will be considered passed if a mark is obtained, which added to the simulation practice marks and preparation of documents from the practice study, is greater than or equal to 5 points. **(This is the second way)**

Anyone enrolled in this subject, who has completed any of the evaluations, may take the recovery activity in order to increase the final mark. If the 1st route had been passed, the final mark will never be lower than the one obtained by the first route.