Course guide
330103 - AC - Circuit Analysis

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

Degree: BACHELOR’S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Compulsory subject).

Academic year: 2023  ECTS Credits: 6.0  Languages: Catalan

LECTURER

Coordinating lecturer: JOSEP FONT TEIXIDO

Others:

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. Acquire the basic concepts for the resolution of electrical and electronic circuits.
2. Design and simulate electronic circuits.

Transversal:
3. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 3. Communicating clearly and efficiently in oral and written presentations. Adapting to audiences and communication aims by using suitable strategies and means.
4. TEAMWORK - Level 3. Managing and making work groups effective. Resolving possible conflicts, valuing working with others, assessing the effectiveness of a team and presenting the final results.
5. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.
7. EFFECTIVE USE OF INFORMATION RESOURCES - Level 3. Planning and using the information necessary for an academic assignment (a final thesis, for example) based on a critical appraisal of the information resources used.

TEACHING METHODOLOGY

- Classes with presentation by the teacher in a large group.
- Medium group directed learning classes. They consist of solving practical exercises, in which the teacher will solve doubts individually or in small groups.
- Resolution and delivery outside the classroom and worked individually or in groups, of proposed problems.
- Continuous evaluation and written tests of problems.
- All support material can be accessed via ATENEA.

LEARNING OBJECTIVES OF THE SUBJECT

Upon completion of the Circuit Analysis course, the student should be able to:
- Know, understand and use the theory and analysis methods of electrical and electronic circuits.
- Properly use component modeling and circuit simulation tools.
STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours large group</td>
<td>45.0</td>
<td>30.00</td>
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<tr>
<td>Hours small group</td>
<td>15.0</td>
<td>10.00</td>
</tr>
<tr>
<td>Self study</td>
<td>90.0</td>
<td>60.00</td>
</tr>
</tbody>
</table>

Total learning time: 150 h

CONTENTS

Content 1: FOUNDATION AND / OR REVIEW OF CONCEPTS

Description:
- Voltage and intensity generators.
- KVL and KCL.
- Equivalents of Thevenin and Norton.
- Voltage and intensity dividers.
- Analysis with equivalent circuits.
- Generator clusters.
- Power and energy.

Specific objectives:
1. Establish prior knowledge.
2. Acquire mastery in specific circuit analysis techniques.

Related activities:
1, 2

Full-or-part-time: 15h
- Theory classes: 4h
- Laboratory classes: 2h
- Self study: 9h

Content 2: OPERATIONAL AMPLIFIER

Description:
- Description and model of the ideal operational amplifier.
- Inverting amplifier.
- Non-inverting amplifier.
- Tension follower.
- Differential amplifier.
- Source of intensity.

Specific objectives:
1. Knowledge of a component that allows to build and / or model active circuits.

Related activities:
1, 2

Full-or-part-time: 15h
- Theory classes: 4h
- Laboratory classes: 2h
- Self study: 9h
### Content 3: PASSIVE REACTIVE ELEMENTS (CAPACITOR - INDUCTOR)

**Description:**
V-I relationships.
Stored energy.

**Specific objectives:**
1. Define and characterize the behavior of the fundamental reactive components.

**Related activities:**
1, 2

**Full-or-part-time:** 5h
Theory classes: 2h
Self study: 3h

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### Content 4: RC AND RL CIRCUITS WITH CONSTANT GENERATOR (ANALYSIS WITH DIFFERENTIAL EQUATIONS)

**Description:**
First order differential equation with constant coefficients and excitation.
Application to RC and RL circuits.

**Specific objectives:**
1. Description and resolution with ODE of two basic circuits.

**Related activities:**
1, 2

**Full-or-part-time:** 15h
Theory classes: 4h
Laboratory classes: 2h
Self study: 9h
(ENG) Contingut 5: ANÀLISI DE CIRCUITS AMB TRANSFORMADA DE LAPLACE

Description:
Laplace transformed model of the fundamental components (R, C, L).
Analysis of passive and active RCL class circuits. Calculation of tensions and / or intensities.
Transient and permanent responses.
Free and forced responses.
Transfer function.
Pole-zero diagram. Stability.
Impedance (admittance) in single port circuits.
Ideal oscillating circuits.
Oscillating circuits with damping.
The transformer.

Specific objectives:
1. Analyze dynamic circuits (RLC class) with the deLaplace transform.
2. Characterize the behavior of the previous circuits from transfer functions.
3. Know the transformer.

Related activities:
1, 3

Full-or-part-time: 40h
   Theory classes: 12h
   Laboratory classes: 4h
   Self study : 24h

Content 6: ANALYSIS IN PERMANENT SENOIDAL REGIME

Description:
Sinusoidal generators: Permanent regime in stable circuits.
Phasor of a sinusoidal variable.
Phasor impedance (admittance) of the fundamental components (R, C, L).
Analysis in RPS. Plan Z (Y). Phasor diagram V-I.
Phasor transfer function. Relationship with the Laplace transfer function.
Impedance (admittance) in single port circuits.
Oscillating circuits. Analysis From the phasor point of view.
The transformer in RPS.

Specific objectives:
1. Analyze the steady-state behavior of RLC class circuits when they are excited by sinusoidal generators of a single frequency.

Related activities:
1, 3

Full-or-part-time: 20h
   Theory classes: 6h
   Laboratory classes: 2h
   Self study : 12h
Content 7: CIRCUITS WITH PERIODIC NON-SENOIDAL GENERATORS

Description:
Fourier series of a periodic generator. Cases of interest (pulse generators, triangular generators, rectified sinusoidal generators). Response of non-sinusoidal periodic generators RLC class circuits.

Specific objectives:
1. Analyze the steady-state behavior of RLC class circuits when they are excited by non-sinusoidal periodic generators.

Related activities:
1, 3

Full-or-part-time: 15h
Theory classes: 5h
Laboratory classes: 1h
Self study: 9h

Content 8: FREQUENCY RESPONSE. WEDDING DIAGRAMS.

Description:
Frequency response from the pole-zero diagram.
Bode diagram (of module and phase).
Gain measurement in dB (decibel). Logarithmic frequency axis (decades and octaves).
Bode diagram (asymptotic and exact) of the basic terms of a transfer function.
Bode diagram (asymptotic and exact) of a transfer function.

Specific objectives:
1. Justify the need to characterize the behavior of a class RLC circuit excited by generators with frequency spectrum.

Related activities:
1, 3

Full-or-part-time: 25h
Theory classes: 8h
Laboratory classes: 2h
Self study: 15h
**ACTIVITIES**

**ACTIVITY 1: PROBLEM SOLVING, IN A GROUP OF 2 STUDENTS**

*Description:*  
Troubleshooting each content with or without PSPICE simulation.

*Specific objectives:*  
Fix the knowledge obtained to each content.

*Material:*  
Statements of the problems.  
Educational PSPICE.  
Class notes.  
Recommended texts.

*Delivery:*  
Report.  
Oral communication student / teacher (individual).  
It represents a part of the continuous evaluation (30%).

*Full-or-part-time:* 65h  
Laboratory classes: 15h  
Self study: 50h

**ACTIVITY 2: WRITTEN TEST**

*Description:*  
Individual test in the classroom related to the learning objectives of the subject contents.

*Specific objectives:*  
Evaluate the general achievement of the objectives of contents 1, 2, 3, 4.

*Material:*  
Statement of the test delivered at the time of the test.

*Delivery:*  
The resolved test is delivered to the teacher.  
Represents a part of the continuous assessment of the specific contents of the subject: 35%.

*Full-or-part-time:* 22h  
Theory classes: 2h  
Self study: 20h
### ACTIVITY 3: WRITTEN TEST

**Description:**
Individual test in the classroom related to the learning objectives of the subject contents.

**Specific objectives:**
Evaluate the general achievement of the objectives of the contents 5,6,7,8.

**Material:**
Statement of the test delivered at the time of the test.

**Delivery:**
The resolved test is delivered to the teacher.
Represents a part of the continuous assessment of the specific contents of the subject: 35%.

**Full-or-part-time:** 22h
- Theory classes: 2h
- Self study: 20h

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### GRADING SYSTEM
- Activity 1: Resolution of proposed problems: 30%
- Activity 2: Written test: 35%
- Activity 3: Written test: 35%

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### EXAMINATION RULES.
If any of the continuous evaluation activities is not carried out, it will be considered as not scored.

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### BIBLIOGRAPHY

**Basic:**

**Complementary:**

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### RESOURCES

**Other resources:**
Circuit simulator (PSPICE).