Course guide
330103 - AC - Circuit Analysis

Last modified: 25/04/2024

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).
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2016). (Compulsory subject).

Academic year: 2024 **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 INFORMATI0N 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

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

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

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 nosenoidal 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 excate) 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
Self study: 50h
Laboratory classes: 15h

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
Self study: 20h
Theory classes: 2h

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
Self study: 20h
Theory classes: 2h

GRADING SYSTEM

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

EXAMINATION RULES.

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

BIBLIOGRAPHY

Basic:
- Thomas, R. E.; Rosa, A. J. Circuitos y señales: una introducción a los circuitos lineales y de acoplamiento. Barcelona: Reverté, 2002. ISBN 8429134581.

Complementary:
- Irwin, J. David. Análisis básico de circuitos en ingeniería [on line]. 6ª ed. México: Limusa Wiley, 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:
Circuit simulator (PSPICE).