Last update: 23-04-2019

320019 - AC - Advanced Circuits

Coordinating unit: 205 - ESEIAAT - Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 709 - EE - Department of Electrical Engineering
Academic year: 2019
Degree: BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
ECTS credits: 6 Teaching languages: Spanish

Teaching staff

Coordinator: Juan Ramón Hermoso

Others: Emiliano Aldabas

Prior skills

Students will be expected to have passed the subject Electrical Systems (third semester).

Degree competences to which the subject contributes

Specific:
1. ELE: Understanding of machine control, electric drive systems and their applications.

Teaching methodology

Face-to-face lecture sessions. In these sessions, the lecturer will explain concepts, guide students and set assignments.
- Applied face-to-face sessions. In these sessions, students will give presentations in groups of six on how they solved the problems in the set assignments. The students who are to give a presentation in a session will be chosen at random, although volunteers may come forward as a certain number of presentations must be given over the course.
- Directed study sessions in which the lecturer will monitor students' progress based on the set assignments.
- Independent learning. Students will be expected to use this time to learn concepts, complete the set assignments and prepare class work.
- Group work Students will be expected to work in pairs to prepare practical exercises and write reports.
They will also work on problems in groups of six whose solutions they will have to defend in the applied face-to-face sessions.

Learning objectives of the subject

- Give basic training in and information about the specialisation.
- Acquire skills in calculus and the interpretation of results.
- Introduce techniques in the analysis and synthesis of circuits.

Last update: 23-04-2019

320019 - AC - Advanced Circuits

Study load

Total learning time: 150h	Hours large group:	30h	20.00%
	Hours medium group:	15h	10.00%
	Hours small group:	15h	10.00%
	Guided activities:	0h	0.00%
	Self study:	90h	60.00%

Last update: 23-04-2019

320019 - AC - Advanced Circuits

Content

TOPIC 1: THREE-PHASE SYSTEMS

Learning time: 30h

Theory classes: 6h
Practical classes: 2h
Laboratory classes: 4h
Self study : 18h

Description:
1.1. Review of balanced three-phase systems
1.2. Unbalanced three-phase systems
1.2.1. Study of voltages and currents
1.2.2. Study of power
1.3. Improving the power factor
1.4. Decomposition into symmetrical components

Related activities:
Practical P1 - Measurements in unbalanced three-phased systems

Specific objectives:
For students to:
- Learn the fundamental behaviour and characteristics of balanced three-phase systems.
- Calculate currents and voltages methodically in unbalanced three-phase systems.
- Calculate power budgets in unbalanced three-phase systems.
- Study the power factor in unbalanced systems.
- Become familiar with and use the decomposition in symmetrical components.

Last update: 23-04-2019

320019 - AC - Advanced Circuits

TOPIC 2: FREQUENCY RESPONSE	Learning time: 31h Theory classes: 6h Practical classes: 3h Laboratory classes: 4h Self study : 18h

Description:
2.1. Analysis of variable frequency response
2.2. Half power frequency
2.3. Resonance
2.3.1. Series resonance
2.3.2. Parallel resonance
2.3.3. Other resonant circuits
2.4.1. Transfer function
2.5. Frequency response logarithmic plots
2.5.1. Bode diagrams
2.6. Passive filters
2.7. Active filters

Related activities:
Practical P2 - Resonance
Practical P3 - Frequency response

Specific objectives:
For students to:
- Understand the concept of impedance using variable frequency.
- Become familiar with electrical resonance.
- Understand the concept of the transfer function.
- Draw frequency response plots.
- Become familiar with the various types of filter circuits.
- Design simple electrical filter circuits.

Last update: 23-04-2019

320019 - AC - Advanced Circuits

TOPIC 3: TRANSIENT ANALYSIS

Learning time: 29h

Theory classes: 6h
Practical classes: 3h
Laboratory classes: 2h
Self study : 18h

Description:
3.1. Introduction to industrial communications.
3.2. Industrial automation and control system architectures: centralised, distributed, hierarchical and CIM.
3.3. Reference models in communications systems: OSI and TCP/IP models.
3.4. Industrial networks and fieldbuses: classification, component parts and characteristics

Related activities:
First class test
Practical P4 - Transient first- and second-order circuits

TOPIC 4: APPLICATION OF FOURIER ANALYSIS IN ELECTRICAL SYSTEMS

Learning time: 29h

Theory classes: 6h
Practical classes: 3h
Laboratory classes: 2h
Self study : 18h

Description:
4.1. Introduction. The permanent non-sinusoidal regime
4.2. Trigonometric forms of the Fourier series
4.3. Evaluation of Fourier coefficients
4.4. Filling factor and wave symmetry
4.5. Response to periodic excitation functions
4.6. Complex forms of the Fourier series
4.7. Fourier integral. Definition
4.8. Applications in electrical circuits
4.9. Power in non-sinusoidal regimes

Related activities:
Practical P5 - Analysis and measurements in non-linear circuits

Specific objectives:
For students to:
- Learn the characteristics and properties of Fourier analysis.
- Calculate voltages and currents in non-linear circuits.
- Calculate power in non-linear single-phase circuits
- Differentiate between power factor and cos(phi)

320019 - AC - Advanced Circuits

TOPIC 5: MODELLING OF CIRCUITS - QUADRUPOLES	Learning time: 14h Theory classes: 2h Practical classes: 2h Laboratory classes: 2h Self study : 8h

Description:
5.1. Definition of quadrupoles
5.2. Impedance and admittance parameters
5.3. Hybrid parameters
5.4. Transmission parameters
5.5. Association of quadrupoles
5.6. The relationship between parameters
5.7. Active quadrupoles

Related activities:
Practical P6 - Determination of parameters in quadrupoles

Specific objectives:
For students to:
- Know the relationship between input and output in a circuit.
- Understand the basic modelling techniques of electrical systems.
- Understand transformation modelling techniques.
- Understand interconnection modelling techniques.

Last update: 23-04-2019

320019 - AC - Advanced Circuits

TOPIC 6: INTRODUCTION TO ELECTRICAL MEASUREMENTS

Learning time: 17h

Theory classes: 4h
Practical classes: 1h
Laboratory classes: 2h
Self study : 10h

Description:

6.1 General concepts
6.1.1. Concepts of measurement and error
6.1.2. Types of error
6.1.3. Statistical applications
6.1.4. Data representation
6.2. Measuring instruments
6.2.1. Functional characteristics
6.2.2. Sources of error
6.2.3. Analogue instruments
6.2.4. Digital instruments
6.2.5. Measurement transformers
6.3. Measuring techniques
6.3.1. Measurement of components (R, L and C)
6.3.2. Measurement of voltage and current
6.3.3. Measurement of power
6.3.4. Measurement of energy
6.3.5. Measurements in three-phase systems

Related activities:

Practical P7 Measurements. Data processing and interpretation
Group work
Second class test

Specific objectives:

For students to:
Understand all of the concepts and factors related to a measuring process.
Use statistical applications.
Use data presentation techniques.
Understand the characteristics of the instruments used.
Understand the basic measuring techniques.

Last update: 23-04-2019

320019 - AC - Advanced Circuits

Planning of activities

PRACTICE P1. MEASURES SYSTEMS UNBALANCED THREE PHASE.

Hours: 3h
Laboratory classes: 2h
Self study: 1h

Description:
Unbalanced three phase circuits are simulated, the active and apparent power and power factor are measured. Finally the three phase circuits resulting from applying the
Stokvis Fortescue theorem are simulated and the results compared.

Support materials:
Script of practice guidelines for the completion of the report and measuring equipment laboratory.

Descriptions of the assignments due and their relation to the assessment:
Throughout the session the report with the data obtained will be filled and responded reasonably to required issues. The note of the labs corresponding to 10% of the overall mark of subject.

Specific objectives:
Studying the power factor in unbalanced systems.
Knowing and using symmetrical components decomposition

PRACTICE P2. RESONANCE

Hours: 3h
Laboratory classes: 2h
Self study: 1h

Description:
RLC series circuit is performed and the frequency that presents pure resistive behaviour is measured. The experiment was repeated but now with a parallel RLC circuit. Finally a mixed circuit is analysed.

Support materials:
Script of practice guidelines for the completion of the report and measuring equipment laboratory.

Descriptions of the assignments due and their relation to the assessment:
Throughout the session the report with the data obtained will be filled and responded reasonably to required issues. The note of the labs corresponding to 10% of the overall mark of subject.

Specific objectives:
Understand the concept of impedance with varying frequency.
Learn the phenomenon of electrical resonance.

PRACTICE P3. FREQUENCY RESPONSE.

Hours: 3h
Laboratory classes: 2h
Self study: 1h

Description:
A circuit consisting of resistors, inductors and capacitors are fed with an alternating voltage variable frequency. After determining the starting point of the relationship between vought and Vin are measured. Then analyse its usefulness to pass some frequencies and attenuate others.

320019 - AC - Advanced Circuits

Support materials:
Script of practice guidelines for the completion of the report and measuring equipment laboratory.

Descriptions of the assignments due and their relation to the assessment:
Throughout the session the report with the data obtained will be filled and responded reasonably to required issues. The note of the labs corresponding to 10% of the overall mark of subject.

Specific objectives:
Understand the concept of transfer function.
Diagrams represent frequency response.
Learn about the different types of filter circuits.

PRESENTIAL FIRST EXAM	Hours: 3h Theory classes: 3h

Description:
The evaluations consist of individual tests and / or other assessment activities.

Support materials:
Enunciated of evidence and / or other material specified by the teacher.

Descriptions of the assignments due and their relation to the assessment:
The first assessment represents 35% of the final grade for the course.

Specific objectives:
After each evaluation the student must have satisfactorily achieved the specific objectives detailed in the contents that have been part of assessments.

PRACTICE P4. TRANSIENT IN FIRST AND SECOND ORDER CIRCUITS	Hours: 3h Laboratory classes: 2h Self study: 1h

Description:
Sallen-Key circuit is made with adjustable gain and the transient response is measured for different values K. Moreover, the transfer function is calculated and determined its poles. Practice will conclude by comparing the measurements with the mathematical study.

Support materials:
Script of practice guidelines for the completion of the report and measuring equipment laboratory.

Descriptions of the assignments due and their relation to the assessment:
Throughout the session the report with the data obtained will be filled and responded reasonably to required issues. The note of the labs corresponding to 10% of the overall mark of subject.

Specific objectives:
Know the different types of possible responses.
Relate the transient response with the transfer function.

320019 - AC - Advanced Circuits

PRACTICE P5. NONLINEAR CIRCUITS, ANALYSIS AND MEASURES	Hours: 3h Laboratory classes: 2h Self study: 1h

Description:
Nonlinear electrical circuit consisting of diodes and resistors are supplied with a sinusoidal signal, obtaining a response known Fourier analysis. Below is a PL filter is placed and measured the new answer. Finally justify analytically the amplitudes of the first three harmonics.

Support materials:
Script of practice guidelines for the completion of the report and measuring equipment laboratory.

Descriptions of the assignments due and their relation to the assessment:
Throughout the session the report with the data obtained will be filled and responded reasonably to required issues. The note of the labs corresponding to 10% of the overall mark of subject.

Specific objectives:
Experiment with electrical circuits in non- sinusoidal steady state.
Evaluate the Fourier coefficients.

PRACTICE P6. DETERMINE PARAMETERS IN QUADRIPOLES.	Hours: 3h Laboratory classes: 2h Self study: 1h

Description:
Will be based on a relatively complex electrical circuit and its parameters will be calculated quadripole equivalent. Both circuits are simulated and the results compared.

Support materials:
Script of practice guidelines for the completion of the report and measuring equipment laboratory.

Descriptions of the assignments due and their relation to the assessment:
Throughout the session the report with the data obtained will be filled and responded reasonably to required issues. The note of the labs corresponding to 10% of the overall mark of subject.

Specific objectives:
Relate the input and output response in a circuit.
Apply the basic techniques of modelling of electrical systems.

PRACTICE P7. MEASURES. INTERPRETATION AND DATA PROCESS.	Hours: 3h Laboratory classes: 2h Self study: 1h

Description:
The accuracy of different measuring equipment shall be verified. Component parameters were measured and the usual electrical magnitudes are also measured.

Support materials:
Script of practice guidelines for the completion of the report and measuring equipment laboratory.

320019 - AC - Advanced Circuits

Descriptions of the assignments due and their relation to the assessment:
Throughout the session the report with the data obtained will be filled and responded reasonably to required issues. The note of the labs corresponding to 10% of the overall mark of subject.

Specific objectives:
Understand the characteristics of the instruments used.
Understand the basic measuring techniques.

WORK IN GROUPS.	Hours: 24h Self study: 24h

Description:
Students work in groups of 6 people, and made collections of problems that must be defended in class time.

Support materials:
Script work and guidelines for implementing the same.

Descriptions of the assignments due and their relation to the assessment:
After completing the course, each group must submit a dossier with all the problems solved. The evaluation of group work will count 15% of the final grade for the course.

Specific objectives:
Fix the knowledge developed in lectures.

PRESENTIAL SECOND EXAM	Hours: 3h Theory classes: 3h

Description:
The evaluations consist of individual tests and / or other assessment activities.

Support materials:
Enunciated of evidence and / or other material specified by the teacher.

Descriptions of the assignments due and their relation to the assessment:
The first assessment represents 40% of the final grade for the course.

Specific objectives:
After each evaluation the student must have satisfactorily achieved the specific objectives detailed in the contents that have been part of assessments.

Last update: 23-04-2019

320019 - AC - Advanced Circuits

Qualification system

- Total Exams: 70%
(1st exam:35%, 2nd exam:35%)
- Workclass: 15%
- Laboratory: 15%
The unsatisfactory results of the 1st partial exam may be redirected by means of a exam to be carried out on the day fixed for the final exam. This test can be done at your discretion, all students enrolled. The grade will be between 0 and 10 and the grade obtained by application of the renewal will replace the initial grade of 1st partial exam, provided it is higher.
exam

For those students who meet the requirements and submit to the reevaluation examination, the grade of the reevaluation exam will replace the grades of all the on-site written evaluation acts (tests, midterm and final exams) and the grades obtained during the course for lab practices, works, projects and presentations will be kept.
If the final grade after reevaluation is lower than 5.0, it will replace the initial one only if it is higher. If the final grade after reevaluation is greater or equal to 5.0, the final grade of the subject will be pass 5.0.

Bibliography

Basic:

Fraile Mora, Jesús. Circuitos eléctricos. Madrid: Pearson Educación, 2012. ISBN 9788483227954.

Complementary:

Irwin, J. David. Análisis básico de circuitos en ingeniería. México: Limusa Wiley, ISBN 9681862953.

Conejo, Antonio J. [et al.]. Circuitos eléctricos para la ingeniería. Madrid [etc.]: Mc Graw Hill, 2004. ISBN 9788448141790.

Carlson, A. Bruce. Teoría de circuitos: ingeniería, conceptos y análisis de circuitos eléctricos lineales. Madrid: International Thomson, 2002. ISBN 8497320662.

Hayt, William H. [et al.]. Análisis de circuitos en ingeniería. 7ª ed. México D.F: McGraw-Hill, 2007. ISBN 9789701061077.