820222 - EAEIA - Analogue Electronics

Coordinating unit: 295 - EEBE - Barcelona East School of Engineering
Teaching unit: 710 - EEL - Department of Electronic Engineering
Academic year: 2017
Degree: BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory) BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
ECTS credits: 6
Teaching languages: Catalan, Spanish, English

Teaching staff
Coordinator: HERMINIO MARTÍNEZ GARCÍA.
Others: HERMINIO MARTÍNEZ GARCÍA y otros a determinar al inicio del cuatrimestre.

Opening hours
Timetable: To determine at the semester beginning. It will be announced to the whole students the first week of the course.

Prior skills
The skills acquired in the following courses of the Bachelor's Degree in Industrial Electronics and Automation Engineering (EIA):

- Electronic Systems (STI - 820017).
- Circuit Theory and Electrical Machines (TCME - 820225).
- Electronics Technology (TE-EIA - 820231).

Requirements

PRE-REQUISITES:

As PRE-REQUISITES, it is mandatory to have completed (attended and passed) the following courses of the Bachelor's Degree in Industrial Electronics and Automation Engineering (EIA):

- Electronic Systems (STI - 820017).
- Circuit Theory and Electrical Machines (TCME - 820225).

CO-REQUISITES:

As CO-REQUISITES, it is mandatory to be enrolled (or to have attended previously) the following courses of the Bachelor's Degree in Industrial Electronics and Automation Engineering (EIA):

- Electronic Technology (TE-EIA - 820231).
- Automatic Control (REGA - 820228).
Degree competences to which the subject contributes

Specific:
1. To know the different types, internal structures, operation and application circuits of commercial devices and integrated circuits for analog signal processing (VFOAs, OTAs, CCIs, CCIIs, CFOAs, etc.).
2. To know the main electrical characteristics and practical limitations (static and dynamic) of the main commercial integrated circuits for analog signal processing.
3. To understand the concept of 'saturated state' and 'non-saturated state', 'linear electronic function' and 'non-linear electronic function'.
4. To know how to analyze, design, simulate, and implement basic and advanced analog systems that implement linear and nonlinear generation of waveforms and sinusoidal oscillators, regulators and voltage references, etc.
5. To know the synthesis of analog and digital filtering structures, the principle of switched capacitor circuits (SC), and the classification and types of SC circuits.
6. To develop skills in simulation techniques and experimental measurement in analog electronic circuits and systems.
7. To use English in advanced information search (manufacturers datasheets, IEEE journal articles, etc.), regarding the presentation of written and oral work in the course.

Transversal:
10. 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.

Teaching methodology

Two theory classes per week with a total of 3.0 h/week, which encompass matter of theory and problems, and 1 h/set. of laboratory classes, grouped into fortnightly sessions.

Additionally, throughout the semester, different classes will be held (schedule will be announced at the beginning of term) with the whole group or part thereof in order to explain, develop and assess cross (generic) competences assigned to the subject.

The course uses:
- Lecture methodology by 40%.
- Individual work by 30%.
- Work in groups by 30%.

The student will develop, in groups of, at most, 2 students, a project of the course design, simulation, and/or implementation related to the content of the course.

Learning objectives of the subject

1.- To know the different types, internal structures, operation and application circuits of commercial devices and integrated circuits for analog signal processing (VFOAs, OTAs, CCIs, CCIIs, CFOAs, etc.).
2.- To know the main electrical characteristics and practical limitations (static and dynamic) of the main commercial integrated circuits for analog signal processing.
3.- To understand the concept of 'saturated state' and 'non-saturated state', 'linear electronic function' and 'non-linear electronic function'.
4.- To know how to analyze, design, simulate, and implement basic and advanced analog systems that implement linear and nonlinear generation of waveforms and sinusoidal oscillators, regulators and voltage references, etc.
5.- To know the synthesis of analog and digital filtering structures, the principle of switched capacitor circuits (SC), and the classification and types of SC circuits.
6.- To develop skills in simulation techniques and experimental measurement in analog electronic circuits and systems.
7.- Autonomus learning and the development of student teamwork.
8.- To use English in advanced information search (manufacturers datasheets, IEEE journal articles, etc.), regarding the presentation of written and oral work in the course.
### Study load

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group:</th>
<th>45h</th>
<th>30.00%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hours medium group:</td>
<td>0h</td>
<td>0.00%</td>
</tr>
<tr>
<td></td>
<td>Hours small group:</td>
<td>15h</td>
<td>10.00%</td>
</tr>
<tr>
<td></td>
<td>Guided activities:</td>
<td>0h</td>
<td>0.00%</td>
</tr>
<tr>
<td></td>
<td>Self study:</td>
<td>90h</td>
<td>60.00%</td>
</tr>
</tbody>
</table>
## Content

<table>
<thead>
<tr>
<th>1. - Analysis and Design of Operational Amplifier Internal Structures.</th>
<th>Learning time: 10h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 5h</td>
</tr>
<tr>
<td></td>
<td>Self study : 5h</td>
</tr>
</tbody>
</table>

**Description:**
Please, see the Spanish or Catalan version.

**Specific objectives:**
Please, see the Spanish or Catalan version of the contents in order to see the detailed course syllabus.

<table>
<thead>
<tr>
<th>2. - Practical Limitations of Analog Integrated Circuits.</th>
<th>Learning time: 8h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 3h</td>
</tr>
<tr>
<td></td>
<td>Self study : 5h</td>
</tr>
</tbody>
</table>

**Description:**
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**Specific objectives:**
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<table>
<thead>
<tr>
<th>3. - Alternatives to VFOA: Commercial Analog Integrated Circuits (OTA, CCI, CCII, CFOA, etc.). Types, Characteristics, and Classification.</th>
<th>Learning time: 8h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 3h</td>
</tr>
<tr>
<td></td>
<td>Self study : 5h</td>
</tr>
</tbody>
</table>

**Description:**
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**Specific objectives:**
Please, see the Spanish or Catalan version of the contents in order to see the detailed course syllabus.
### 4.- Implementation of Linear and Non-Linear Electronic Functions by Means of Analog Integrated Circuits Operating in Non-Saturation and Saturation Zones.

<table>
<thead>
<tr>
<th>Learning time:</th>
<th>12h 30m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes:</td>
<td>3h 30m</td>
</tr>
<tr>
<td>Laboratory classes:</td>
<td>4h</td>
</tr>
<tr>
<td>Self study:</td>
<td>5h</td>
</tr>
</tbody>
</table>

**Description:**
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**Specific objectives:**
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### 5.- Frequency Response of Transistor Amplifiers.

<table>
<thead>
<tr>
<th>Learning time:</th>
<th>14h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes:</td>
<td>4h</td>
</tr>
<tr>
<td>Self study:</td>
<td>10h</td>
</tr>
</tbody>
</table>

**Description:**
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**Specific objectives:**
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### 6.- Transistor and VFOA Feedback Amplifiers: Effects of the Negative and Positive Feedback.

<table>
<thead>
<tr>
<th>Learning time:</th>
<th>8h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes:</td>
<td>3h</td>
</tr>
<tr>
<td>Self study:</td>
<td>5h</td>
</tr>
</tbody>
</table>

**Description:**
Please, see the Spanish or Catalan version of the contents in order to see the detailed course syllabus.

**Specific objectives:**
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<table>
<thead>
<tr>
<th>Topic</th>
<th>Learning time</th>
<th>Description</th>
<th>Specific objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.- Time Circuits, Signal Generation and Sinusoidal Oscillators.</td>
<td><strong>Learning time: 18h</strong>&lt;br&gt;Theory classes: 4h&lt;br&gt;Laboratory classes: 4h&lt;br&gt;Self study: 10h</td>
<td>Please, see the Spanish or Catalan version of the contents in order to see the detailed course syllabus.</td>
<td>Please, see the Spanish or Catalan version of the contents in order to see the detailed course syllabus.</td>
</tr>
<tr>
<td>8.- Continuous and Discrete Transfer Functions: 's' and 'z' Transforms for Electrical Filter.</td>
<td><strong>Learning time: 8h 30m</strong>&lt;br&gt;Theory classes: 3h 30m&lt;br&gt;Self study: 5h</td>
<td>Please, see the Spanish or Catalan version of the contents in order to see the detailed course syllabus.</td>
<td>Please, see the Spanish or Catalan version of the contents in order to see the detailed course syllabus.</td>
</tr>
<tr>
<td>9.- Continuous-Time and Digital Active Filtering Cells. Design and Analysis of High-Order Filters by Means of Polynomials, Tables, and Software.</td>
<td><strong>Learning time: 19h</strong>&lt;br&gt;Theory classes: 5h&lt;br&gt;Laboratory classes: 4h&lt;br&gt;Self study: 10h</td>
<td>Please, see the Spanish or Catalan version of the contents in order to see the detailed course syllabus.</td>
<td>Please, see the Spanish or Catalan version of the contents in order to see the detailed course syllabus.</td>
</tr>
<tr>
<td>Topic</td>
<td>Description</td>
<td>Specific objectives</td>
<td>Learning time</td>
</tr>
<tr>
<td>-------</td>
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<td>---------------------</td>
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</tr>
<tr>
<td>10.- Switched-Capacitor Circuits (SCC) and Programmable Analog Devices (FPAAs).</td>
<td>Please, see the Spanish or Catalan version of the contents in order to see the detailed course syllabus.</td>
<td>Please, see the Spanish or Catalan version of the contents in order to see the detailed course syllabus.</td>
<td>11h</td>
</tr>
<tr>
<td>11.- Power Amplification: Output Stages.</td>
<td>Please, see the Spanish or Catalan version of the contents in order to see the detailed course syllabus.</td>
<td>Please, see the Spanish or Catalan version of the contents in order to see the detailed course syllabus.</td>
<td>13h</td>
</tr>
<tr>
<td>12.- Current and Voltage Regulators and References.</td>
<td>Please, see the Spanish or Catalan version of the contents in order to see the detailed course syllabus.</td>
<td>Please, see the Spanish or Catalan version of the contents in order to see the detailed course syllabus.</td>
<td>13h</td>
</tr>
</tbody>
</table>
13.- Other Important Applications of the Analog Electronics.

Learning time: 7h
- Theory classes: 2h
- Self study: 5h

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Specific objectives:
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Qualification system
The grade or scoring of the course will be carried out according to:

- 1 or 2 midterm exams: 20%.
- Final Exam: 40%.
- Course project (project to design, simulate, and implement analog electronic systems): 20%.
- Laboratory activities and tests: 20%.

All these tasks will also serve to assess the cross (generic) competences assigned to the course.

This course does not have re-assessment test ("prova de reavaluació").

Regulations for carrying out activities
The implementation of the different tests consists of:

- Midterm exams: written tests, theoretical or sizing problems of solar energy testing, and analysis and/or synthesis (design) of analog electronic systems.
- Final exam: written, theoretical and/or sizing problems of solar energy test, and analysis and synthesis (design) of analog electronic systems.
- Course project: The course project will involve conducting course design work, sizing and/or simulation related to the contents of the subject.
- Activities, testing and laboratory experiments: Laboratory experiences and activities on Electronics Engineering.

Thanks to all these tasks, the cross (generic) competences assigned to the course will be also evaluated.
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Bibliography

Basic:


Complementary:


Others resources:

Please, see the Spanish or Catalan version of the contents in order to see the detailed course syllabus.

Hyperlink

Moodle ATENEA: http://atenea.upc.edu/moodle/