340127 - INEL-K6O10 - Electronic Instrumentation

Coordinating unit: 340 - EPSEVG - Vilanova i la Geltrú School of Engineering
Teaching unit: 710 - EEL - Department of Electronic Engineering
Academic year: 2019
Degree: BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
ECTS credits: 6
Teaching languages: Catalan

Teaching staff
Coordinator: Joaquín del Río Fernández
Others: Joaquín del Río Fernandez

Degree competences to which the subject contributes

Specific:
6. CE20. Fundamental knowledge and application of analogue electronics.

Transversal:
1. 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.
2. EFFECTIVE USE OF INFORMATION RESOURCES. Managing the acquisition, structure, analysis and display of information from the own field of specialization. Taking a critical stance with regard to the results obtained.
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 2. Contributing to the consolidation of a team by planning targets and working efficiently to favor communication, task assignment and cohesion.
5. TEAMWORK. Being able to work as a team player, either as a member or as a leader. Contributing to projects pragmatically and responsibly, by reaching commitments in accordance to the resources that are available.

Teaching methodology
The fundamental concepts will be explained in lectures, and from students' personal and guided works, concepts and applications will be learned. The lectures dedicated to solve problems will involve the participation of students, allowing them to solve real practical problems. These actions will be complemented with laboratory sessions, software simulations and the evaluation of the results, all these in the context of an instrumentation project design, which includes a research stage and a team work collaboration.

Learning objectives of the subject
The purpose of this course is to study and learn the most common techniques for electronic measurements of electrical and physical parameters of an industrial environment. From the study of the main transducers, signal conditioners and associated electronic circuits, instrumentation and data acquisition systems will be developed for the subsequent data processing of the information obtained from the different measurement environments. The foundations and structure of various equipment for general use and specific instrumentation, will be analyzed as well.

### Study load

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group:</th>
<th>30h</th>
<th>20.00%</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>30h</td>
<td>20.00%</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>Instrumentation and Measurement Chain Overview</th>
<th>Learning time: 8h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 2h</td>
</tr>
<tr>
<td></td>
<td>Practical classes: 1h</td>
</tr>
<tr>
<td></td>
<td>Laboratory classes: 1h</td>
</tr>
<tr>
<td></td>
<td>Guided activities: 0h</td>
</tr>
<tr>
<td></td>
<td>Self study: 4h</td>
</tr>
</tbody>
</table>

Description:

Specific objectives:
General overview of instrumentation systems. Study of basic concepts.

<table>
<thead>
<tr>
<th>Instrumentation Amplifiers</th>
<th>Learning time: 33h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 6h</td>
</tr>
<tr>
<td></td>
<td>Practical classes: 3h</td>
</tr>
<tr>
<td></td>
<td>Laboratory classes: 3h</td>
</tr>
<tr>
<td></td>
<td>Guided activities: 1h</td>
</tr>
<tr>
<td></td>
<td>Self study: 20h</td>
</tr>
</tbody>
</table>

Description:
The need for amplification of the measured signal. Ideal and real operational amplifiers. Differential and instrumentation amplifiers. The isolation amplifier

Related activities:
Laboratory Practice
Laboratory Written Test
Delivery of solved problems collection

Specific objectives:
Get in touch with concepts related to signal conditioning, such as common mode and differential voltages. CMRR. Load effect.
### Transducers and Measurement Converters

**Learning time:** 38h  
Theory classes: 8h  
Practical classes: 4h  
Laboratory classes: 4h  
Guided activities: 2h  
Self study: 20h

**Description:**  

**Related activities:**  
Delivery of solved problems collection  
Written theory test - problems

**Specific objectives:**  
Analyze and design measurement systems for reference industrial parameters.

### Analog Functions and Measured Signals

**Learning time:** 28h  
Theory classes: 6h  
Practical classes: 3h  
Laboratory classes: 3h  
Guided activities: 1h  
Self study: 15h

**Description:**  
Logarithmic and antilog converters. Analog multipliers. Integrated multifunction modules. Applications

**Specific objectives:**  
Study of different systems for linearization and analog signal processing
### THE ELECTRONIC ASSOCIATED TO THE DIGITAL MEASUREMENT CHAIN

**Description:**
Components of the digital measurement chain. The architecture of data acquisition systems. Digital/Analog and Analog/Digital converters. Sample and Hold circuits. Voltage/Frequency Converters

**Related activities:**
Delivery of solved problems collection  
Practical work in groups

**Specific objectives:**
Study of the Analog/Digital interface.

<table>
<thead>
<tr>
<th>Learning time: 24h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes: 4h</td>
</tr>
<tr>
<td>Practical classes: 2h</td>
</tr>
<tr>
<td>Laboratory classes: 2h</td>
</tr>
<tr>
<td>Guided activities: 1h</td>
</tr>
<tr>
<td>Self study: 15h</td>
</tr>
</tbody>
</table>

### ANALYSIS AND DESIGN OF INSTRUMENTATION.

**Description:**
Design phases of a measurement equipment. Design tools. Industrial communication systems. Transmission Lines. Communication within the same equipment (I2C, SPI, etc). Communication between equipments (GPIB, current loop, RS232, Ethernet, USB, etc). Wireless systems.

**Related activities:**
Laboratory Practice  
Laboratory Written Test  
Written theory test -problems

**Specific objectives:**
To have a general overview of the measurement systems, and the phases of industrial design of electronic equipment.

<table>
<thead>
<tr>
<th>Learning time: 19h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes: 4h</td>
</tr>
<tr>
<td>Practical classes: 2h</td>
</tr>
<tr>
<td>Laboratory classes: 2h</td>
</tr>
<tr>
<td>Guided activities: 1h</td>
</tr>
<tr>
<td>Self study: 10h</td>
</tr>
</tbody>
</table>
COVID-19
40% theory grade (exams, 20% first part, 20% second part, or 40% final exam)
30% grade of the laboratory (20% preparatory work, 10% reports).
30% grade of weekly exercises delivered through atenea.

Bibliography

Basic:

Complementary:

Others resources:
- Exams repository:
  https://examens.upc.edu/curs/340127/683