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.
9. CE24. Ability to design electronical, analog, digital and power systems.

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.

<table>
<thead>
<tr>
<th>Study load</th>
<th>Hours large group:</th>
<th>Hours medium group:</th>
<th>Hours small group:</th>
<th>Guided activities:</th>
<th>Self study:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total learning time:</strong> 150h</td>
<td>30h</td>
<td>0h</td>
<td>30h</td>
<td>0h</td>
<td>90h</td>
</tr>
<tr>
<td></td>
<td>20.00%</td>
<td>0.00%</td>
<td>20.00%</td>
<td>0.00%</td>
<td>60.00%</td>
</tr>
</tbody>
</table>
### INSTRUMENTATION AND MEASUREMENT CHAIN OVERVIEW

**Description:**

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

<table>
<thead>
<tr>
<th>Learning time:</th>
<th>8h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes:</td>
<td>2h</td>
</tr>
<tr>
<td>Practical classes:</td>
<td>1h</td>
</tr>
<tr>
<td>Laboratory classes:</td>
<td>1h</td>
</tr>
<tr>
<td>Guided activities:</td>
<td>0h</td>
</tr>
<tr>
<td>Self study:</td>
<td>4h</td>
</tr>
</tbody>
</table>

### INSTRUMENTATION AMPLIFIERS

**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.

<table>
<thead>
<tr>
<th>Learning time:</th>
<th>33h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes:</td>
<td>6h</td>
</tr>
<tr>
<td>Practical classes:</td>
<td>3h</td>
</tr>
<tr>
<td>Laboratory classes:</td>
<td>3h</td>
</tr>
<tr>
<td>Guided activities:</td>
<td>1h</td>
</tr>
<tr>
<td>Self study:</td>
<td>20h</td>
</tr>
</tbody>
</table>
# Transducers and Measurement Converters

**Description:**

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

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

<table>
<thead>
<tr>
<th>Learning time: 38h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes: 8h</td>
</tr>
<tr>
<td>Practical classes: 4h</td>
</tr>
<tr>
<td>Laboratory classes: 4h</td>
</tr>
<tr>
<td>Guided activities: 2h</td>
</tr>
<tr>
<td>Self study : 20h</td>
</tr>
</tbody>
</table>

---

# Analog Functions and Measured Signals

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

**Specific objectives:**
Study of different systems for linearization and analog signal processing

<table>
<thead>
<tr>
<th>Learning time: 28h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes: 6h</td>
</tr>
<tr>
<td>Practical classes: 3h</td>
</tr>
<tr>
<td>Laboratory classes: 3h</td>
</tr>
<tr>
<td>Guided activities: 1h</td>
</tr>
<tr>
<td>Self study : 15h</td>
</tr>
</tbody>
</table>
### THE ELECTRONIC ASSOCIATED TO THE DIGITAL MEASUREMENT CHAIN

**Learning time:** 24h  
Theory classes: 4h  
Practical classes: 2h  
Laboratory classes: 2h  
Guided activities: 1h  
Self study: 15h

#### 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.

### ANALYSIS AND DESIGN OF INSTRUMENTATION.

**Learning time:** 19h  
Theory classes: 4h  
Practical classes: 2h  
Laboratory classes: 2h  
Guided activities: 1h  
Self study: 10h

#### 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.
Qualification system

60% theory grade (exams)  
40% grade of the laboratory exam.  
Theory note = 30% 1st partial + 30% 2nd partial  
Laboratory note = grade of the exam at the laboratory. It will be necessary to deliver laboratory reports to be able to do the laboratory exam.  
It is a necessary condition to pass the subject to carry out the practices in the laboratory, present the associated reports and take the laboratory exam.

Bibliography

Basic:


Complementary:


Others resources:

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