320041 - IE - Electronic Instrumentation

Coordinating unit: 205 - ESEIAAT - Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 710 - EEL - Department of Electronic Engineering
Academic year: 2018
Degree: BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
ECTS credits: 6
Teaching languages: Catalan, Spanish

Teaching staff
Coordinator: Juan Antonio Gallardo León
Others: Lluis Ferrer

Prior skills
Students might have passed the course of Analog Electronics.

Degree competences to which the subject contributes
Specific:
2. ELO: Applied knowledge of electronic instrumentation

Transversal:
1. 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
Sessions:
a) Theoretical sessions. The professor presents the content
b) Sessions in the laboratory. Students will do a number of practical experiences in a laboratory.
c) Evaluation sessions.
Class work:
d) Individual study and solving exercises.
e) Preparation of work and practical exercises to deliver.
f) Preparation of the practices carried out in the laboratory sessions.

Learning objectives of the subject
Knowing devices, equipment and techniques common in measurements electronic systems as its essential knowledge. Students will acquire the ability to analyze and design a complete system for measuring industrial, environmental, biomedical or other physical magnitudes. Because of the set of quantities that can be measured and the associated electronic systems is very large, is introduced only the most general and/or common, and are provided for additional references and websites so that students can extend the range of alternatives, if necessary.
### Study load

<table>
<thead>
<tr>
<th></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></td>
<td>150h</td>
<td>45h</td>
<td>0h</td>
<td>0h</td>
<td>90h</td>
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<tr>
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<td>30.00%</td>
<td>0.00%</td>
<td>10.00%</td>
<td>60.00%</td>
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</tbody>
</table>

Last update: 13-09-2018
### Content

<table>
<thead>
<tr>
<th><strong>TOPIC 1: Introduction</strong></th>
<th><strong>Learning time:</strong> 10h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 2h</td>
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<tr>
<td></td>
<td>Laboratory classes: 2h</td>
</tr>
<tr>
<td></td>
<td>Self study: 6h</td>
</tr>
</tbody>
</table>

**Description:**
- General structure of measurement systems.
- Specifications of transducers.

**Specific objectives:**
(ENG) S’introduïen la terminologia bàsica (especificacions) i els efectes físics més habituals del món de les mesures.

<table>
<thead>
<tr>
<th><strong>TOPIC 2: Preparation of signal measure</strong></th>
<th><strong>Learning time:</strong> 32h 30m</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 10h</td>
</tr>
<tr>
<td></td>
<td>Laboratory classes: 3h</td>
</tr>
<tr>
<td></td>
<td>Self study: 19h 30m</td>
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</table>

**Description:**
- Types of signals in measurement systems.
- Amplification of the signal. Common mode effects.
- Instrumentation amplifier.
- Linearization.
- Effect of interference.

**Related activities:**
Analysis and design of analog circuits leading electronic measurement systems.
### TOPIC 3: Digital signal processing

<table>
<thead>
<tr>
<th>Description:</th>
<th>Learning time: 20h</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Sampling signal measurement.</td>
<td>Theory classes: 6h</td>
</tr>
<tr>
<td>- Converters D / A</td>
<td>Laboratory classes: 2h</td>
</tr>
<tr>
<td>- A / D converter</td>
<td>Self study: 12h</td>
</tr>
<tr>
<td>- Actual signal acquisition systems of measurement.</td>
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<tr>
<td>- Measurement signal Transmission.</td>
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**Related activities:**
Introduce techniques and their associated circuits, which allow assembling the signals produced by transducers in digital systems.

### TOPIC 4: Temperature Transducers

<table>
<thead>
<tr>
<th>Description:</th>
<th>Learning time: 30h</th>
</tr>
</thead>
<tbody>
<tr>
<td>- The temperature measurement.</td>
<td>Theory classes: 8h</td>
</tr>
<tr>
<td>- Resistive temperature detectors (RTD).</td>
<td>Laboratory classes: 4h</td>
</tr>
<tr>
<td>- Integrated temperature sensors.</td>
<td>Self study: 18h</td>
</tr>
<tr>
<td>- Thermocouples.</td>
<td></td>
</tr>
</tbody>
</table>

**Specific objectives:**
(ENG) Donar les bases conceptuals per poder triar adequadament el transductor més idoni per efectuar mesures de temperatura en un entorn real, així com per utilitzar-lo acuradament.
### TOPIC 5: Transducers of mechanical variables

<table>
<thead>
<tr>
<th>Learning time: 22h 30m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes: 7h</td>
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<tr>
<td>Laboratory classes: 2h</td>
</tr>
<tr>
<td>Self study : 13h 30m</td>
</tr>
</tbody>
</table>

**Description:**
- Fundamentals of strain gages.
- Load Cells.
- Pressure sensors.
- Accelerometers and inclinometers.
- Measurement of displacement and position.

**Specific objectives:**
(ENG) Donar les bases conceptuales per poder triar adequadament els transductors més idonis per efectuar mesures d’esforç, de pes, de pressió i d’altres variables mecàniques en un entorn real, així com per utilitzar-los acuratament.

### TOPIC 6: New trends in measurement systems

<table>
<thead>
<tr>
<th>Learning time: 20h</th>
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<tr>
<td>Theory classes: 6h</td>
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<tr>
<td>Laboratory classes: 2h</td>
</tr>
<tr>
<td>Self study : 12h</td>
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**Description:**
- Smart sensors.
- Sensor networks.
- Virtual instrumentation.

**Specific objectives:**
(ENG) Donar a conèixer les darreres tendències en sensòrica, connexió sense fils de sensors i la instrumentació virtual.
TOPIC 7: Other transducers

Learning time: 15h
- Theory classes: 6h
- Self study: 9h

Description:
- Flow transducers.
- Level sensors.
- Light sensors and magnetic quantities.
- Quantities of chemical and environmental sensors.

Specific objectives:
(ENG) Donar les bases conceptuales per poder triar adequadament els transductors més idonis per efectuar mesures de cabdal i de nivell, químiques, magnètiques, lúminiques i altres variables en un entorn real, així com per utilitzar-los acuradament.

Qualification system

- 1st test: 25%
- 2nd test: 45%
- Lab: 30% (75% working in lab, 25% test)

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:

Complementary: