Learning objectives of the subject:

The aim of this course is to train students in methods of design, implementation and operation of advanced instrumentation and sensor systems. This includes instrumentation and sensor networks, advanced sensor conditioning methods, smart sensor systems and error analysis. Also reliability, electrical safety and electromagnetic compatibility issues are covered.
Learning results of the subject:

- Ability to understand the physical principles and manufacturing technologies of advanced sensors.
- Know how to design and manage instrument and sensor networks and associated synchronization problems.
- Knowledge of various techniques of collecting energy from the environment.
- Ability to understand the technical specifications of high-sensitivity and high frequency measurement equipment.
- Knowledge of the basic principles of the calibration of instruments and the techniques used to carry it out.
- Ability to design virtual instrumentation and automatic test systems.
- Knowledge for integrating instrumentation systems on mobile devices.
- Ability to interpret the regulations affecting electronic products.
- Knowledge of the various tests required to verify electronic products.

Study load

<table>
<thead>
<tr>
<th>Total learning time: 125h</th>
<th>Hours large group: 26h</th>
<th>20.80%</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Hours medium group: 0h</td>
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<tr>
<td></td>
<td>Hours small group: 13h</td>
<td>10.40%</td>
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<tr>
<td></td>
<td>Guided activities: 0h</td>
<td>0.00%</td>
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<tr>
<td></td>
<td>Self study: 86h</td>
<td>68.80%</td>
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</tbody>
</table>
# 230643 - IS - Instrumentation and Sensors

## Content

<table>
<thead>
<tr>
<th>1. Introduction</th>
<th>Learning time: 7h</th>
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<tbody>
<tr>
<td></td>
<td>Theory classes: 2h</td>
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<tr>
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<td>Guided activities: 1h</td>
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<td>Self study : 4h</td>
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</tbody>
</table>

**Description:**
- Instrumentation systems architecture
- Sensor networks architecture
- Data transfer and power supply needs of instrumentation and sensor systems
- General considerations about instrumentation and sensor system specification and verification

<table>
<thead>
<tr>
<th>2. Instrumentation systems</th>
<th>Learning time: 51h</th>
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<tbody>
<tr>
<td></td>
<td>Theory classes: 10h</td>
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<td></td>
<td>Laboratory classes: 6h</td>
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<td></td>
<td>Guided activities: 10h</td>
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<tr>
<td></td>
<td>Self study : 25h</td>
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**Description:**
- Advanced instrumentation systems architectures
- Virtual instrumentation
- Error analysis and specification
- Estimation theory
- Instrumentation systems calibration techniques

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<thead>
<tr>
<th>3. Sensor systems</th>
<th>Learning time: 53h</th>
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<tbody>
<tr>
<td></td>
<td>Theory classes: 9h</td>
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<tr>
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<td>Laboratory classes: 8h</td>
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<td>Guided activities: 10h</td>
</tr>
<tr>
<td></td>
<td>Self study : 26h</td>
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</tbody>
</table>

**Description:**
- Sensor principles, implementation and characteristics review
- Advanced sensor conditioning techniques
- Coherent detection methods for AC sensors
- Self-correction and self-calibration techniques
- Smart-sensor structure and standards
- Sensor networks
- Energy harvesting techniques for sensor systems
4. Reliability, electrical safety and electromagnetic compatibility in measurement systems

| Description: |
| - Electromagnetic compatibility issues in measurement systems |
| - Interference identification and reduction techniques |
| - Electrical safety |
| - Reliability |

Learning time: 14h
- Theory classes: 4h
- Guided activities: 4h
- Self study: 6h

Planning of activities

LABORATORY

Description:
- Synchronization techniques on LXI
- Instrument calibration
- Guarding and shielding
- Coherent and synchronous detection of AC sensors
- Self-calibration of a sensor
- IEEE 1451 Smart sensor standard implementation

EXERCISES

Description:
- Exercises to strengthen the theoretical knowledge
- Guided study of sensors, instruments and methods related materials

SHORT ANSWER TEST (CONTROL)

Description:
Mid term control.

EXTENDED ANSWER TEST (FINAL EXAMINATION)

Description:
Final examination.
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Qualification system

Final examination: 40%
Partial examinations and controls: 10%
Exercises: 20%
Laboratory assessments: 30%

Bibliography

Basic:


Complementary: