

11589 - SSC - Sensors and Signal Conditioning

Coordinating unit: 230 - ETSETB - Escola Tècnica Superior d'Enginyeria de Telecomunicació de Barcelona
Teaching unit: 710 - EEL - Department of Electronic Engineering
Academic year: 2011
Degree: MASTER OF SCIENCE IN INFORMATION AND COMMUNICATION TECHNOLOGIES (Syllabus 2006).
(Teaching unit Optative)
TELECOMMUNICATION ENGINEERING (Syllabus 1992). (Teaching unit Optative)
ECTS credits: 5 Teaching languages: English

Teaching staff

Coordinator: RAMON BRAGOS BARDIA

Others: SERGEY YURISH

Prior skills

Physical properties of materials used in electronics. Electromagnetism and magnetic circuits. Electronic circuits analysis. Interpretation and use of analog integrated circuits specifications. Signal acquisition. Analysis of errors in electronic circuits. Use of basic measurement instruments.

Requirements

Teaching methodology

Lectures. Problem solving. Guided laboratory activities. Project based learning.

Learning objectives of the subject

Study of sensors: operation, properties and limitations. Specific interface design: amplitude and time-frequency approaches. Applications.

Basic contents of the course are: Sensors, sensor signal conditioning, analog and mixed-mode signal processing, acquisition, calibration techniques, smart sensors interface protocols.

Content

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1. Introduction to sensor-based measuring systems. Primary sensors (2 hours)

Description:

- 1.1. General concepts
- 1.2. General input-output configuration
- 1.3. Static and dynamic characteristics
- 1.4. Generalized input impedance
- 1.5. Primary sensors

2. Sensors with electrical output (4 hours)

Description:

- 2.1. Variable resistance sensors
- 2.2. Reactive and electromagnetic sensors
- 2.3. Generating sensors

3. Conditioning circuits for sensors. Amplitude measurement approach (8 hours)

Description:

- 3.1 DC linear conditioning circuits for resistive sensors
- 3.2 AC linear conditioning circuits for resistive and reactive sensors
- 3.3 Low drift conditioning circuits for generating sensors

4. Conditioning circuits for sensors. Time-frequency conversion approach (14 hours)

Description:

- 4.1 Quasi-digital sensors state-of-the-art
- 4.2 Time and frequency based sensor conditioning techniques. Direct sensor-to-microcontroller interface
- 4.3 Sensor interface chips and integrated frequency-to-digital converters
- 4.4 Digital and smart sensors
- 4.5 Smart sensors systems design
- 4.6 IEEE 1451 standard for smart sensors and its extension for quasi-digital sensors and transducers

Lab1. Characterization of a sensor-based measurement system (2 hours)

Lab2. Scale based on a load cell and an instrumentation amplifier (4 hours)

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Lab3. Thermistor based thermometer. Analog and numerical linearization (4 hours)

Lab4. Capacitive sensor conditioning. Non-coherent and coherent amplitude detection (4 hours)

Lab5. Time and frequency sensor conditioning. Universal frequency-to-digital converter (2 hours)

Lab6. Smart data acquisition system for quasi-digital sensors. Quartz-accurate automated calibration technique (2 hours)

Project based learning (PBL). Open project on Data Acquisition and Smart System Design for Quasi-Digital Sensors (10 hours)

Qualification system

Continuous assessment of laboratory activities and project

50 %

Continuous assessment of problems

10 %

Final exam

40 %

Regulations for carrying out activities

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Bibliography

Basic:

Pallas Areny, R.; Webster, J.G. *Sensors and signal conditioning*. 2nd ed. John Wiley and Sons, 2001. ISBN 0471332321.

Kirianaki, N.V. [et al.]. *Data acquisition and signal processing for smart sensors*. John Wiley and Sons, 2002. ISBN 0470843179.

Complementary:

Webster, J.G. *The measurement, instrumentation and sensors handbook*. CRC ; IEEE, 1999. ISBN 0780347250.

Yurish, S.Y.; Gomes, M.T.S.R. *Smart sensors and MEMS*. Springer, 2004. ISBN 1402029284.

Others resources:

Laboratory activities manuals and resources