UNIVERSITAT POLITÈCNICA DE CATALUNYA
BARCELONATECH
Escola Tècnica Superior d'Enginyeria de Telecomunicació de Barcelona

telecos BCN

230737 – INTRODUCTION TO MEASUREMENT SYSTEMS

Credits: 5 ECTS

LECTURER

Coordinating lecturer: Juan Ramos Castro

Others: Miquel Angel García González, Josep Ma. Torrents Dolz

PRIOR SKILLS

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Transversal:

TEAMWORK. Being able to work as a member of an interdisciplinary team, either as a member or carrying out management tasks, in order to contribute to developing projects with pragmatism and a sense of responsibility, assuming commitments taking into account the available resources.

EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialization and critically assessing the results obtained.
FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labor market.

TEACHING METHODOLOGY

- Lectures
- Application classes
- Laboratory classes
- Laboratory practical work
- Group work (distance)
- Individual work (distance)
- Exercises
- Extended answer test (Final Exam)

LEARNING OBJECTIVES OF THE SUBJECT

Learning objectives of the subject:

Introduce the student to the basics of measurement science, electronic instrumentation, sensors and signal conditioning.

Learning results of the subject:

- Specify, design and use electronic instrumentation and measurement systems. Know the principles of measurement theory and the main estimators. Capacity to adequately express and estimate uncertainty in measurement results. Know the origins and effects of noise and interference in systems of measure. Know the operating principles of sensors. Understand the need and know the structure of conditioning circuits basics.

STUDY LOAD

Hours large group: 26

Hours small group: 13

Hours self study: 86

CONTENTS

Theory

1. Introduction to measurement theory
    Basic terminology, Sources of uncertainty and categories
    Uncertainty evaluation and management in measurements

    Full-or-part-time: 21h
    Theory classes: 6h
    Self study : 15h

2. Time and frequency domain magnitude estimation
    Basic descriptions: linear physical systems, statistical principles, random variables
    Time and frequency estimators

    Full-or-part-time: 21h
    Theory classes: 6h
    Self study : 15h

3. Sensors and signal conditioning
    Modulating sensors
    Generating sensors

    Full-or-part-time: 28h
    Theory classes: 8h
    Self study : 20h

4. Data acquisition systems
    Signal multiplexing
    A/D D/A conversion

    Full-or-part-time: 14h
    Theory classes: 4h
    Self study : 10h

Lab

L1. Introduction to the instrumentation laboratory

Familiarization with the laboratory work environment
Use of LabView for signal simulation

Full-or-part-time: 7h
Laboratory classes: 2h
Self study : 5h

L2. Assessment of type A & B uncertainty in measurements with digital multimeters
Evaluation with digital multimeter measuring AC+DC voltage for various types of signal sources

Full-or-part-time: 7h
Laboratory classes: 2h
Self study : 5h

L3. Automatic measurements with digital oscilloscopes in the instrumentation laboratory
Automatically measure a filter frequency response

Full-or-part-time: 7h
Laboratory classes: 2h
Self study : 5h

L4. Characterization and measurement of an NTC thermistor. Application to temperature measurement for drift correction.
Basic conditioning circuit of an NTC
Characterization and calibration of a measurement system

Full-or-part-time: 7h
Laboratory classes: 2h
Self study : 5h

L5. Calibration of a load cell
Conditioning of a load cell
Obtaining the response function

Full-or-part-time: 7h
Laboratory classes: 2h
Self study : 5h

GRADING SYSTEM

- Final examination: 45 %
- Partial examination (control): 15 %
- Exercises : 10 %
- Laboratory assessments: 30 %

BIBLIOGRAPHY

Basic:

- Pallás-Areny, Ramón; Webster, John G. Sensors and signal conditioning [on line]. 2nd ed. New York: John Wiley & Sons, 2001 [C o n s u l t a t i o n : 0 3 / 0 2 / 2 0 2 1] . A v a i l a b l e o n : https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?docID=4747125. ISBN0471332321.

- Webster, J.G.; Eren, H. (eds.). Measurement, instrumentation and sensors handbook : electromagnetic, optical, radiation, chemical, and biomedical measurement [on line]. 2nd ed. Boca Raton: CRC Press, 2014 [Consultation: 17/03/2021]. Available on: https://ebookcentral.proquest.com/lib/upcatalunya-ebooks/detail.action?docID=1407945. ISBN 9781138072183.

- Fraden, J. Handbook of modern sensors : physics, designs, and applications [on line]. 5th ed. Cham: Springer International Publishing, 2016 [Consultation: 07/07/2020]. Available on: https://dx.doi.org/10.1007/978-3-319-19303-8. ISBN 9783319193038.

-Julius S. Bendat, Allan G. Piersol. Random data : analysis and measurement procedures. 3rd ed. New York etc. : John Wiley & Sons, 2000. ISBN 978047131733.