

Academic Year: (2023 / 2024)

Review date: 28-04-2023

Department assigned to the subject: Electronic Technology Department

Coordinating teacher: GARCIA SOUTO, JOSE ANTONIO

Type: Compulsory ECTS Credits : 3.0

Year : 1 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

No prerequisites.

OBJECTIVES

- 1.- To know the general principles associated with the measurement of physical quantities and instrumentation, as well as the metrological characterization of instrumentation systems.
- 2.- To know the different types of sensors according to different classifications, examples of classical instrumentation systems and their application to the measurement of physical quantities.
- 3.- To know and understand the fundamental components of a measurement instrumentation system: sensors, signal conditioning and data acquisition.
- 4.- To know the physical limits of the measurement processes and to calculate the metrological parameters associated with these limitations.
- 5.- To know the most common instrumentation techniques in advanced instrumentation systems.

DESCRIPTION OF CONTENTS: PROGRAMME

- 1.- Instrumentation and measurement systems
 - 1.1 Architecture of instrumentation systems
 - 1.2 Metrological characteristics
 - 1.3 Measurement uncertainty
 - 1.4 Measurement standards
- 2.- Sensors and their application to physical measurements
 - 2.1 Types of sensors
 - 2.2 Examples of measurement of physical quantities
- 3.- Signal conditioning and data acquisition
 - 3.1 Analog conditioning
 - 3.2 Instrumentation amplifiers
 - 3.3 Analog-to-digital conversion
 - 3.4 Data acquisition systems
- 4.- Resolution and accuracy in instrumentation systems
 - 4.1 Thermodynamic noise and quantification noise
 - 4.2 Resolution evaluation of instrumentation systems
 - 4.3 Interference and other sources of measurement errors
- 5.- Advanced instrumentation systems
 - 5.1 Modulation and phase sensitive detection
 - 5.2 Lock-in amplifiers

LEARNING ACTIVITIES AND METHODOLOGY

Lectures, where the basic knowledge to be acquired by the students will be presented. Students will have class notes and reference bibliography that will allow them to complete and deepen their knowledge of the subject.

Practical sessions oriented to the resolution of exercises and discussion of examples in the context of practical cases. These classes will be complemented with the resolution of practical exercises by the students, individually or in groups.

Group laboratory practices.

Group tutorials.

ASSESSMENT SYSTEM

1. Test-type or reasoned questionnaires as part of the continuous evaluation and in the final exam.
2. Questions related to the instrumentation system developed in the laboratory.
3. Laboratory practices with previous questions, set-up of a system, measurements in the laboratory and documentation with results and conclusions.
4. Analysis and design problems of instrumentation systems in the final exam.

Ordinary call:

The students will carry out in group a work and a laboratory practice that will represent 20% of the evaluation. On the other hand, they will complete two questionnaires that will represent 20% of the evaluation. Finally, they will perform a theoretical-practical test as a final exam, corresponding to 60% of the evaluation.

Extraordinary call:

Based on continuous assessment and final exam with the same weights of the ordinary call. Optionally it can be based solely on a final exam (100%).

% end-of-term-examination:	60
% of continuous assessment (assignments, laboratory, practicals...):	40

BASIC BIBLIOGRAPHY

- 1 Robert B. Northrop Introduction to Instrumentation and Measurements (Third Edition), CRC Press (2014).

ADDITIONAL BIBLIOGRAPHY

- Alan S. Morris, and Reza Langari Measurement and Instrumentation - Theory and Application, Elsevier (on-line), 2011
- Andrea Cataldo, et al. Basic Theory and Laboratory Experiments in Measurement and Instrumentation: A Practice-Oriented Guide, Springer International Publishing (on-line), 2020
- Jacob Fraden Handbook of Modern Sensors. Physics, Designs, and Applications (Third Edition), Springer, 2004
- James A. Blackburn Modern Instrumentation for Scientists and Engineers, Springer, 2001

BASIC ELECTRONIC RESOURCES

- Pablo Acedo Gallardo, José A. García Souto . OpenCourseWare (OCW) - Electronic Instrumentation and Laboratory of Electronic Instrumentation (2009): <http://ocw.uc3m.es/tecnologia-electronica/electronic-instrumentation-and-laboratory-of-electronic-instrumentation>