Electronic Instrumentation

Academic Year: (2023 / 2024) **Review date: 16-03-2023**

Department assigned to the subject: Electronic Technology Department

Coordinating teacher: ZUMEL VAQUERO, PABLO

Type: Compulsory ECTS Credits : 6.0

Year : 3 Semester :

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

- Electronics Engineering Fundamentals
- Electrical Engineering Fundamentals

OBJECTIVES

- Acquiring knowledge and understanding of electronic instrumentation systems' physical and mathematical principles from an applied engineering perspective.
- Acquiring the ability to apply knowledge and understanding of electronic instrumentation to identify, formulate and solve engineering problems within the industrial environment, and recognize specifications using established methods of analysis of circuit design and electronic instrumentation systems.
- Acquiring the ability to use appropriate methods to conduct research and make innovative contributions in the field of Industrial Engineering, and specifically in the field of electronic instrumentation.
-Acquiring e the ability to apply the knowledge and understanding of electronic instrumentation to solve problems and to design devices or processes in the field of industrial engineering according to criteria of cost, quality, safety, efficiency and respect for the environment.
- Acquiring basic technical and laboratory skills, handling of electronic laboratory equipment and interpretation of results.
- Acquiring the ability to perform bibliographic searches, use databases and other sources of information to apply them to the design of basic electronic instrumentation systems.
- Acquiring the ability to combine theory and practice to solve engineering problems by applying electronic instrumentation technologies.

DESCRIPTION OF CONTENTS: PROGRAMME

1. Introduction to Electronic Instrumentation
1.1. Basic structure of an electronic instrumentation system
1.2. Characteristic of an electronic instrumentation system
1.3. Errors and uncertainty
1.4. Calibration curve
2. Analog signal processing
2.1. Amplification: circuits based on operational amplifiers (OA)
2.2. Frequency response in electronics systems
2.3. Filtering: active filters based on OAs
2.4. Other applications of OAs (linear and non linear)
3. Sensor and conditioning circuits
3.1. Resistive sensors
3.2. Capacitive sensors
3.3. Inductive sensors
3.4. Thermocouples
3.5. Optoelectronics and fiber optic based sensors
3.6. Other sensors: piezoelectrics, pyroelectrics, Hall effect and biosensors.
3.7. 555 timer: sensors based on the measurement of time and frequency
4. A/D and D/A conversion
4.1. Introduction: AD and DA conversion in instrumentation
4.2. A/D conversion: fundamentals
4.3. A/D converters: static and dynamic characteristics and errors.
4.4. A/D converters: architectures, comparison and selection criteria.
4.5. D/A conversion: fundamentals
4.6. D/A converters: characteristics, architectures and selection criteria

5. Digital signal processing (DSP)
5.1. Introduction to DSP systems
5.2. Basic architectures of a microprocessor
5.3. Digital signal processors and advanced microcontrollers
5.4. Instrumentation with FPGA
5.5. Data acquisition systems
6. Introduction to the design
6.1. Real components: datasheet and interpretation
6.2. Simulation of electronic circuits applied to instrumentation systems
7. Remote sensing
7.1. Introductions to remote sensing: basic elements
7.2. Voltage and current loops: basic concepts about noise and interferences
7.3. Introduction to the modulation and demodulation of signals
7.4. Introduction to the industrial communications systems: field buses

Students will carry out in groups three lab works:
Lab 1.- Basic sensors 1
Lab 2.- Basic sensors 2
Lab 3 and 4.- Sensor and conditioning circuits application

Finally, students will carry out a practical design project. Students will be grouped in teams of three. A written report and a practical examination will be evaluation elements of the project.

LEARNING ACTIVITIES AND METHODOLOGY

- Theory classes, problem resolutions classes, individual tutorials and student personal homework oriented to theoretical knowledge acquisition.

- Laboratory sessions and student personal homework; oriented to practical knowledge related to the fields of the course.

- Development of a design project related to the contents of the course.

ASSESSMENT SYSTEM

The assessment is based on the following criteria:
a) Design Project, consisting of the design, assembly and characterization of a basic instrumentation electronic system. The mark will be assigned considering a Project report and a practical exam showing the operation of the system. The design Project has a 20% weight in the final score of the student if it follows the ongoing evaluation.
b) Midterm exam, which comprises a first thematic block. This midterm exam has a 20% weight in the final score of the student if it follows the ongoing evaluation
c) Final Exam: The student¿s ability to analyze and/or design electronic instrumentation circuits. This exam has a weight of 60% in the final score. A minimum qualification of 4.0 in this final exam and a weighted average equal to 5.0 are required to pass the subject.
Percentage of Final Exam: 60%
Percentage of Evaluation of Other Activities: 40%

Extraordinary Call: Assessment can be fitted to continuous assessment process (with the same percentages as in the ordinary exam) or with a final exam with the 100% of qualification

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

BASIC BIBLIOGRAPHY

- Miguel A. Pérez García et al INSTRUMENTACIÓN ELECTRÓNICA, Thomson, 2003 o posterior

- Miguel Ángel Pérez García Instumentación Electrónica. 230 problemas resueltos, Garceta grupo editorial, 2012

ADDITIONAL BIBLIOGRAPHY

- Fiore, James M. Amplificadores operacionales y circuitos integrados lineales : teoría y aplicación, Thomson-Paraninfo, 2002
- RAMÓN PALLÁS ARENY SENSORES Y ACONDICIONADORES DE SEÑAL, MARCOMBO, S.A., 2005 o posterior

BASIC ELECTRONIC RESOURCES

- Carmen Vázquez, Ernesto García Ares . OCW-UC3M Instrumentación electrónica I: http://ocw.uc3m.es/tecnologia-electronica/instrumentacion-electronica-i