Electronic Instrumentation

Academic Year: (2019 / 2020) **Review date: 07-05-2019**

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

- Basic knowledge of electronics instrumentation.
- Basic practical knowledge of lab equipment.
- Design, documentation and communication of a technical project, specifically on electronica instrumentation.
- Ability to solve problems with initiative, decision making, creativity, critical reasoning and to communicate and transmit knowledge, skills in the field of Industrial Engineering, and specifically in Electronic Instrumentation
- Knowledge and ability to apply computational and experimental tools for the analysis and quantification of problems in Industrial Engineering, using techniques based on Electronic Instrumentation
- Knowledge in an area of ¿¿study starting in the base of general secondary education that reaches a level that, although supported by advanced textbooks, also includes some aspects that imply the use of knowledge in the leading edge of the field of study
- Ability of the students to apply their knowledge to their work in a professional way and other skills that are usually demonstrated through the elaboration and defense of arguments and problem solving within their area of ¿¿study

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
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.- Temperature sensors
Lab 2.- Strain gauge sensors
Lab 3.- Sensor for the design project

Finally, students will carry out a practical design project during three weeks. Students will be grouped in teams of three. A printed report and a practical lab 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 practices and student personal homework; oriented to practical knowledge related with the fields of the course.

- Development of a design project related with the contents od the course.

ASSESSMENT SYSTEM

The assessment is based on the following criteria:
a) Laboratory practices: They are compulsory. In these practices the knowledge acquired by the student will be assessed with the development of some practical cases, previously studied in the theory and problems lectures (15% of the final score).
b) Design Project, consisting on 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 30% weight in the final score of the student if it follows the ongoing evaluation.
c) Midterm exam, which comprises a first thematic block. This midterm exam has a 15% weight in the final score of the student if it follows the ongoing evaluation
d) Final Exam: The student¿s ability to analyze and/or design of electronic instrumentation circuits. This exam has a weight of 40% in the final score if the student follows the ongoing evaluation. If the student does not follow the ongoing evaluation, then the weight is 60%. 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: 40%
Percentage of Evaluation of Other Activities: 60%

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

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

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