Electronic Instrumentation in Energy Systems

Academic Year: (2021 / 2022) **Review date: 08/06/2021 17:56:14**

Department assigned to the subject: Electronic Technology Department

Coordinating teacher: SANCHEZ MONTERO, DAVID RICARDO

Type: Electives ECTS Credits : 3.0

Year : 4 Semester :

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

- Electronics Engineering Fundamentals (3rd Year, 1st Semester). It is strongly recommended to have it passed.

OBJECTIVES

The goal of the course is to allow the student understanding and being able to design some parts of most common sensor and conditioning systems in industrial applications for energetic purposes.
To achieve this goal, the student must acquire the following competences and skills:
- A knowledge of electronics and optoelectronics sensors
- A knowledge, and ability to use of measurement equipments
- An ability to design basic conditioning circuits for commercial sensors
- An ability to design and evaluate instrumentation systems for different applications within energetic systems.
- An ability to select between commercial sensors and their related electronics and optoelectronics instrumentation for measuring different magnitudes.

DESCRIPTION OF CONTENTS: PROGRAMME

THEORY:

1. INTRODUCTION
1.1 What are instrumentation systems useful for?
1.2 Instrumentation systems blocks
1.3. An example of an instrumentation system in energetic systems

2. TRANSDUCERS
2.1 Definition
2.2 Advantages and disadvantages of electronic sensors
2.3 Active and passive sensors.
2.4 Classification.

3. SENSOR CHARACTERISTICS
3.1 Static and dynamic operation regime
3.2. Accuracy
3.3. Calibration curve
3.4. Input and output range
3.5. Sensitivity
3.6. Non-linearity
3.7. Resolution
3.8. Hysteresis and other characteristics
3.9. Bandwidth

4. SIGNAL CONDITIONING
4.1 Basic signal conditioning characteristics

4.2 Potentiometric circuit
4.3 Wheatstone bridge circuit
4.4 Amplification
4.5. Modulation and demodulation
4.6 Analog to digital conversion

5. TEMPERATURE SENSORS AND SIGNAL CONDITIONING
5.1 Applications
5.2. Mechanic temperature sensors
5.3. Integrated circuits thermometers and signal conditioning
5.4. Resistive thermometers and signal conditioning
5.5. Thermocouples
5.6. Different temperature sensors comparison

6. STRAIN SENSORS AND SIGNAL CONDITIONING
6.1. Applications and basic elastic principles
6.2. Operation principles
6.3. Types of extensometers.
6.4. Static characteristics and installation issues
6.5. Conditioning circuits

7. LEVEL AND POSITION SENSORS AND SIGNAL CONDITIONING
7.1. Applications and measuring principles
7.2. Resistive potentiometers and signal conditioning
7.3. Hall effect sensors
7.4. Inductive and capacitive sensors and signal conditioning

8. OPTICAL SENSORS AND SIGNAL CONDITIONING
8.1 Light properties. Basic light sources and photometry
8.2. Light detector resistance and signal conditioning
8.3. Photodiodes and phototransistors and signal conditioning
8.4. Solar cells and photomultipliers
8.5. Fiber-optic sensors

LABORATORY:
Implementation of some laboratory practices with the aim of develop examples of electronic instrumentation systems to measure physical magnitudes which can be of interest in industrial sensing solutions applied to energetic systems.

LEARNING ACTIVITIES AND METHODOLOGY

- Theory - Lectures , problem resolution ¿ Seminars, individual tutorials and student personal homework; oriented to theoretical knowledge acquisition.

- Personal homework to solve proposed exercises useful for self-evaluation and knowledge acquisition.

- Laboratory practices oriented to practical knowledge related with the contents of the course.

ASSESSMENT SYSTEM

% end-of-term-examination/test:	30
% of continuous assessment (assigments, laboratory, practicals…):	70

The evaluation allows knowing the degree of satisfaction of the knowledge goal, thus all work of the students will be evaluated by using continuous evaluation of their activities by using exercises, exams, lab projects, and other activities. The following scoring will be used:

A. Students will obtain 70% of the final score from:
* Delivery of an individual portfolio that includes proposed problems and exercises to be solved for homework: 30%.
* Lab work. Evaluation of the final report/s (or lab project/s memory) which have been implemented and tested at the lab. Project memory organization and written correctness will be evaluated: 40%.

B. Final exam that includes questions and problems: 30%. At least a score of 3 out of 10 is required.

% end-of-term-examination/test:	30
% of continuous assessment (assigments, laboratory, practicals…):	70

BASIC BIBLIOGRAPHY

- A.M. Lázaro Problemas resueltos de instrumentación y medidas eléctricas , Marcombo, 1998

- E. Udd Fiber Optic Sensors: An Introduction for Engineers and Scientists , Wiley, 2011

- J. T. Humphries Industrial Electronics , Delmar , 1993

- M. A. Pérez García et al. Instrumentación Electrónica , Thompson, 2004