Electronic Instrumentation in Energy Systems

Academic Year: (2020 / 2021) **Review date: 30-06-2020**

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 (2nd Course, 2nd Semester). It is of utmost importance to have enough background on this issue.

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.
LEARNING OUTCOMES. By the end of this content area, students will be able to have:

1. knowledge and understanding of the different available electronic sensing solutions in the energy industry, their practical applications and limitations.
2. knowledge and understanding of the different techniques for conditioning the signal provided by a sensor/transducer, and their limitations.
3. knowledge and ability to apply basic signal treatment procedures from a sensor¿s signal by means of electronic circuits and stages.
4. the ability to combine theory and practice to solve problems about electronic instrumentation.
5. The ability to analyse, to design and to document an electronic/optoelectronic instrumentation system for its application in an energy system.
6. the ability to design and conduct appropriate experiments and apply the technical skills acquired for the experimental evaluation of an electronic instrumentation system as well as to properly analyse and interpret the results/data obtained from an engineering point of view, and to draw conclusions about the system performance.
7. an effective behaviour as an individual and as a member of a team.
8. awareness of the health, safety and legal issues and responsibilities of engineering practice, the impact of engineering solutions in a societal and environmental context, and commit to professional ethics, responsibilities and norms of engineering practice.
9. recognised the need for, and have the ability to engage in independent, life-long learning.

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

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: 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
- R. Pallás Areny Sensores y acondicionadores de señal, Marcombo, 1998