Electronic Instrumentation I

Academic Year: (2020 / 2021) **Review date: 04-02-2021**

Department assigned to the subject: Electronic Technology Department

Coordinating teacher: VAZQUEZ GARCIA, MARIA CARMEN

Type: Compulsory ECTS Credits : 6.0

Year : 3 Semester : 2

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

If possible:
Fundamentals of Electronics Engineering
Analog Electronics

OBJECTIVES

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

1. A systematic understanding of the key aspects and concepts of their branch of engineering in electronic instrumentation;
2. A coherent knowledge of their branch of engineering including some at the forefront of the branch in electronic instrumentation;
3. The ability to apply their knowledge and understanding of electronic instrumentation to identify, formulate and solve engineering problems using established methods;
4. The ability to apply their knowledge and understanding to develop and realise designs to meet defined and specified requirements;
5. An understanding of design methodologies, and an ability to use them in the design of electronics instrumentation systems.
6. workshop and laboratory skills.
7. The ability to select and use appropriate equipment, tools and methods;
8. The ability to combine theory and practice to solve problems of electronic instrumentation;
9. An understanding of applicable techniques and methods in electronic instrumentation, and of their limitations;

DESCRIPTION OF CONTENTS: PROGRAMME

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

2. TRANSDUCERS
2.1 Definition
2.2 Advantages and disadvantages of electronic sensors
2.3 Active and pasive sensors.
2.4 Clasification.

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. Hysteresys and other characteristics
3.9. Bandwidth

4. SIGNAL CONDITIONING
4.1 Basic signal conditioning characteristics
4.2 Potentiometric circuit

4.3 Wheastone bridge circuito
4.4 Amplification
4.5. Modulation and demodulation
4.6 Analog to digital conversion
4.7 Instrumentation System

5. TEMPERATURE SENSORS AND SIGNAL CONDITIONING
5.1 Applications
5.2. Mechanic temperatura sensors
5.3. Integrated circuits thermometers and signal conditioning
5.4. Resistive thermometers and signal conditioning
5.5. Thermocouplers
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 instalation conditions
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

LEARNING ACTIVITIES AND METHODOLOGY

- Lectures using online teaching with the platform provided by the University, typically Black Board Collaborate.
o Static and dynamic sensor characteristics and theoretical concepts for designing conditioning circuits related to the sensor type and application
o Examples on lectures of using theoretical concepts and practical use of commercial sensors, for being able to select a specific sensor technology depending on the requirements of the industrial applications
o Communication skills are enhanced through reading of materials and written reports in English and Spanish.
- Practical exercises in lectures.
o Problems are developed for being able to understand commercial sensor datasheets and circuits; students solve them individually or in groups of 2-3 students
o Practical examples on extracting information from calibration curves
o Identification of sensor technologies by analyzing manufacturer data sheets and installed instrumentation systems
o To extract conclusions, they must also analyze, and interpret data and the following methodology is used
o teacher provides questionnaires related to lab sessions and theoretical concepts which are fill in by the students and can be discussed in some aspects in class;
o afterwards they usually form groups of 2-3 students and prepare a report to be used in the session lab,
- Activities related to Lab work.
- Students must design and execute lab experiments with teacher support, such as:
o characterizing temperature and strain sensors,
o strain instrumentation system evaluation
o design on some conditioning circuits for temperature and strain measurements
- Being able to use lab instrumentation: oscilloscopes, power sources, voltmeters
- Being able to put to work and instrumentation system from discrete components (sensors, IC amplifiers...) and evaluate their correct performance
- To extract conclusions, they must also analyze, and interpret data, comparing their results with manufacturer data sheets and required specifications; the following methodology is used
o every student group (made up of usually 2-3 students) prepare a report on expected results

on lab sessions and theoretical concepts to be developed in the lab, individual work can be exceptionally developed with the consent of the teacher
o after measuring on the lab, students analyze and interpret the measured data and prepare a final report
- Students are required to use commercial software and provide solutions to real-world problems.
- They develop capacity to apply theoretical concepts and design some parts following certain specifications, and capacity to make an experiment and a critical discussion of the results.

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) Individual short exams: 25%.

b) Academic activities related to Lab experiments: 30%.
* Theoretical reports with expected results and used of instrumentation: 10%
* Technical reports related to measurements and simulation results and final discussion: 20%
Evaluation of tools usage and circuits and link performance

As an alternative to the continuous evaluation, a final exam with a total value of 60% of10 will be made to the students not following continuous evaluation.

d) Final exam with questions and problems: 45%.
At least a score of 3.5 out of 10 should be obtained in this final exam to pass the course with the continuous assessment.

* To assess theory concepts, problem solving abilities and knowledge of contemporary issues affected by novel technologies.

% end-of-term-examination:	45
% of continuous assessment (assigments, laboratory, practicals…):	55

BASIC BIBLIOGRAPHY

- Clyde F.Coombs Jr. Electronic Instrument Handbook, McGraw-Hill Professional, 2000
- García M. A. Pérez Instrumentación Electrónica, Online, 2014
- H S Kalsi Electronics Instrumentation, Online, 2018
- Humphries J.T Industrial Electronics, Delmar, 1993..
- R. Pallás Areny O. Casas Sensores y acondicionadores de señal, Mancorbo 2005.
- U.A.Bakshi, A.V.Bakshi Electronic Instrumentation, Technical Publications, 2009

ADDITIONAL BIBLIOGRAPHY

- C. Vázquez E. García, J.R.López, Guarnizo Vídeo manejo de instrumental básico en laboratorio de instrumentación electrónica, https://arcamm.uc3m.es/arcamm_3/item/show/871d5cd159869dad199e7fdd6a3d4c73.