COURSE DATA

Data Subject	
Code	34823
Name	Sensors and Virtual Instrumentation
Cycle	Grade
ECTS Credits	6.0
Academic year	2018 - 2019

Study (s)

Degree	Center	Acad. year	Period
1402 - Degree in Telecommunications Electronic Engineering	School of Engineering	4	First term

Subject-matter

Degree	Subject-matter	Character
1402 - Degree in Telecommunications Electronic Engineering	22 - Optional subjects	Optional

Coordination

Name	Department
RAMIREZ MUÑOZ, DIEGO	242 - Electronic Engineering

SUMMARY

The subject Sensors and Virtual Instrumentation is intended for students interested to know the fundamental sensor types that can be found in industry or technical lab to make correct measurements of variables of electrical and non-electrical nature and their electronic interfaces. Additionally, the student will learn how to design virtual instrumentation addressed to acquire by a PC the signal coming from sensors and to control stand-alone electronic equipments using standard instrumentation buses.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

It is highly desirable that students have knowledge of analysis and mathematical calculus, electrical network theory and analogue and digital components.

OUTCOMES

LEARNING OUTCOMES

- RA-1. Be able to perform basic electronic equipment measurements relating to the accuracy limitations of the measuring system.
- RA-2. Determine which is the contribution to the accuracy of the measuring system of the various stages that constitute the basis of their actual behavior.
- RA-3. Ability to apply the appropriate electronic conditioning for measuring certain variable by using a specific sensor.
- RA-4. Being able to propose valid solutions to new problems of sensing and signal conditioning.
- RA-5. Being able to develop and control electronic systems oriented to the test and measurement engineering.

DESCRIPTION OF CONTENTS

1. Resistance sensors.

Strain gauges. Resistive temperature detectors. Thermistors. Light-dependent resistors. The Wheatstone bridge. Types of signals. Electronic signals conditioning.

2. Reactance variation sensors, electromagnetic sensors and their electronic conditioning.

Capacitive sensors. Inductive sensors. Hall sensors. Basic conditioning. AC bridges and electronic conditioning. Envelop detection. Coherent demodulation.

3. Self-generating sensors.

Thermoelectric sensors: thermocouples. Low offset and low drifts building blocks. Electrometers.

4. Other sensing methods.

Semiconductor junction-based sensors. photodiodes.

5. Laboratory

1 Introduction to remote instrument control via GPIB bus.
2 Temperature measurement with linearized thermistor.
3 Electric current sensing technologies.
4 Developing a virtual instrument applied to acceleration measurement using the data acquisition card NI-USB6008.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	30,00	100
Laboratory practices	20,00	100
Classroom practices	10,00	100
Development of group work	24,00	0
Study and independent work	20,00	0
Preparation of evaluation activities	12,00	0
Preparation of practical classes and problem	34,00	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

The development of the course is structured around four themes: the theory sessions, problems, tutorials, continuous evaluation tests, and presentation of technical documentation practices. Group learning with the teacher

With respect to group learning with the teacher (sessions of theory and problems), use the lecture model. At the excercise class, the teacher will explain a number of problems by which the student will learn to identify the essential elements to solve them. These sessions will also use the participatory approach in order to facilitate communication between students and student / teacher.

Tutorial time

The students have a schedule of tutorial time aimed to solving the problems, doubts, work orientation, etc.. The schedule of these tutorials will be indicated at the beginning of the academic year.

Individual Study

The student may submit the resolution of a series of proposed tests. These are voluntary and must be resolved exclusively by the students without any help from the teacher.

Laboratory sessions

They will be organized around groups preferably formed by two people who should be planned for the design, assembly and different experimental works. At any time, if the teacher sees fit, the working group may be separated so that each member worked individually. Each practice combines experimental and theoretical activities, the estimated time for resolution is 3 hours.

Teaching materials

The student will have in the virtual classroom over the academic year, the following documents:

Teaching Guide: provides sufficient data elements to determine what it is intended that the student learns, how it will do, under what conditions and how it will be evaluated.

Presentations from each of the course topics.

Problem of each lesson.

Continuous Tests (PECs) of each of the lessons.

The script of laboratory practices.

EVALUATION

In the first and second announcements the theory and laboratory work will be examined with a weight on the final grade of 50% and 50% respectively. For averaging the ratings of theory and laboratory they must be separately equal or greater than 4.

Getting the theory mark

At the **first announcement**, the theory mark will emerge as a result of:

1. A **practical design of a sensor-based measurement system** according to the proposed teacher specifications. The solution will be shown and defensed on the date stated in the oficial exams calendar. A written material must be delivered on that date in order to show all the topics covered by the practical-design specification. The practical design measurement system must be worked individually or in a two students group.

2. As a formative assessment, the student will deliver on the date specified by the teacher the **continuous tests** (CT). These tests must be sent only in one PDF file to the teacher before the date indicated. Other formats will be returned. Whatever CT not delivered will be computed as zero at the time to compute the $CT_{average}$.

In that way, the theory mark will be obtained according to the following expression:

$$Mark_{theory}=0,8 \times Mark_{Proposed\ design} + 0,2 \times CTs_{average}$$

At the **second announcement**, the theory mark will emerge as a result of:

1. A **written exam** consisting of four or five practical issues related to the course contents and with similar difficulty to the issues and problems done in class.

Thus the theory mark will be obtained according to the following expression:

$$Mark_{theory}= Mark_{Written\ exam}$$

Getting the laboratory mark

Note: Attendance to laboratory classes is compulsory and in any case it must be satisfied that explained in the point 9, art. 6 of the Reglament d'avaluació i qualificació de la Universitat de València per a títols de Grau i Màster.

Depending on the characteristics of the practice it will be shown, prior to entry in the laboratory certain calculations and designs necessary for the realization of the experience. It will not be enter to the lab if they have not been made previously.

At the **first anouncement** the laboratory mark will be the result of the three following assessments:

Note: Depending on the characteristics of the practice it is required, prior to entry in the laboratory to do certain calculations and designs necessary for the realization of the experience. It will not be enter to the lab if they have not been previously.

The laboratory note emerge from the three following assessments:

1. Score of the Experimental Practice (GPE), which scored 40% of the working laboratory. It assessed the skill demonstrated, interest in the assembly, the domain in the use of laboratory equipment and development of practice throughout the session. The score of the Experimental Practices will be delivered by groups of two.

2. Score from the memories (M) that the teacher has asked each of the groups (30%). The reports or results (R) may be well arranged at any time during the academic year, so it is recommended that each student has a lab notebook, since students must deliver in the same session as the teacher requires them. This part will score 30% of the working laboratory.

Thus laboratory mark will be obtained according to the following expression:

$$Mark_{Lab} =0,4 \times GPE + 0,3 \times M + 0,3 \times R$$

If the student fails the Laboratory,

At the **second anouncement:**

- The student must submit the lab exercices and designs solved (GP). They will be the 40% of the working laboratory mark.

- In the official lab announcement date the student will have 3 hours to perform the experimental setup and adjustment of a proposed circuit (ME). This part will be a 60% of the working laboratory.

Thus, the laboratory score will be obtained by the expression:

$$Mark_{Lab} = 0{,}4 \text{ x } GP + 0{,}6 \text{ x } ME$$

The final mark of the subject, provided the theory and lab marks are equal or greater than 4, will be obtained in both anouncements, according to the following expression:

$$Mark_{Subject} = 0{,}5 \text{ x } Mark_{Theory} + 0{,}5 \text{ x } Mark_{Lab}$$

In any case the evaluation will be submitted to the statements of Reglament d'avaluació i qualificació de la Universitat de València per a títols de Grau i Màster

(https://webges.uv.es/uvTaeWeb/MuestraInformacionEdictoPublicoFrontAction.do?accion=inicio&idEdictoSeleccionado=5639).

REFERENCES

Basic

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- Franco, S.; Diseño con amplificadores operacionales y circuitos integrados, McGraw-Hill 3ª Ed., New York, 2005.
- Pérez, M. A.; Álvarez, J. C.; Campos, J. C.; Ferrero, F. J.; Grillo, G. J.: Instrumentación Electrónica. Ed. Thomson, Madrid, 2003.
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Additional

- Fraden, J., "AIP Handbook of modern sensors", AIP Press, NY 1993.
- Analog Devices: Linear Design Seminar. Norwood, MA, 1995.
- Pallàs Areny, R.; Webster, J. G.: Analog Signal Processing. Wiley-Interscience, N. Y., 1999.
- Doebelin, E. O.: Measurement Systems: Application and Design, 3ª ed. Mc-Graw-Hill, New York, 1983.
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