

**COURSE DATA****Data Subject**

Code	34823
Name	Sensors and Virtual Instrumentation
Cycle	Grade
ECTS Credits	6.0
Academic year	2020 - 2021

Study (s)

Degree	Center	Acad. year	Period
1402 - Degree in Telecommunications Electronic Engineering	School of Engineering	4	Second 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. Self-generating sensors.

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

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. Other sensing methods.

Semiconductor junction-based sensors. Photodiodes.

**4. Resistance sensors.**

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

5. Laboratory

- 1 Introduction to remote instrument control by GPIB bus.
- 2 Temperature measurement with linearized thermistor.
- 3 Electric current sensing technologies.
- 4 Instrumentation system based on the data acquisition card NI-USB6008 and virtual instrument.

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 exercise 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

At the first and second announcements the theory and laboratory work will be examined with a weight on the final mark 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 be the result of:

1. A **practical design** of a sensor-based measurement system according to the proposed teacher specifications. The solution will be shown and defended on the date stated in the official 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 CTaverage.



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

$$\text{Theory} = 0,8 \times \text{Proposed design} + 0,2 \times \text{CTsaverage}$$

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

A **written exam** consisting of 4 or 5 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:

$$\text{Theory} = 0.8 \times \text{Written exam} + 0,2 \times \text{CTsaverage}$$

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 announcement** the laboratory mark will be the result of the two following assessments:

1. A mark obtained from the experimental activities and additional questions proposed in each experience (EA), with a weight of 60%. It will assess the demonstrated skill, interest in the assembly, the domain in the use of laboratory equipment and development of practice throughout the session.
2. A mark obtained from the experimental activities and additional questions proposed in each experience (AP). They must be returned at the date proposed by the teacher. It will be mainly considered the organization and capacity of the student to work in group, the clarity of presentation and designs made. This will score 40% of the laboratory mark.

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

$$\text{Laboratory} = 0,6 \times \text{EA} + 0,4 \times \text{AP}$$

At the **second announcement**:

1. The student must submit solved all the proposed designs, off-line and complementary activities (PD). They will be the 40% of the working laboratory mark.
2. At the official lab announcement date the student will have 3 hours to perform the experimental setup and adjustment of a proposed circuit (PC). This part will be a 60% of the laboratory mark.

Thus, the final laboratory mark will be obtained by the expression:

$$\text{Laboratory} = 0,4 \times \text{PD} + 0,6 \times \text{PC}$$



If any of the parts (Theory or Laboratory) will have a mark lower than 4 it will not be submitted to averaging and it will have to be recovered in a later call. The final mark of the subject, provided the theory and lab marks were equal or greater than 4, will be obtained according to the following expression:

$$\text{Subject} = 0,6 \times \text{Theory} + 0,4 \times \text{Laboratory}$$

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

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- Analog Devices: Linear Design Seminar. Norwood, MA, 1995.
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- Morris, Alan S, Measurement and Instrumentation Principles, Jordan Hill: Elsevier Science, 2001, ISBN: 9780080496481 (electronic bk.)
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- Nawrocki, Waldemar, Measurement systems and sensors, Boston: Artech House, c2005, ISBN: 1580539459 (alk. paper)
- Dunn, Patrick F., Fundamentals of sensors for engineering and science / Patrick F. Dunn, Boca Raton, Florida; London; New York: CRC Press, 2012, ISBN: 9781439875308 (e-book)

ADDENDUM COVID-19

This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council

Contents

The contents initially included in the teaching guide are maintained.

Workload and temporary teaching planning

The different activities described in the teaching guide are maintained with the planned dedication.

The material for the follow-up of the classes of theory/practices allows to continue with the professor of temporary planning so much in days as in schedule, so much if the teaching is face-to-face in the classroom or if it is not.

Teaching methodology

In classroom theory and practices, students will tend to have the maximum physical attendance possible, always respecting the sanitary restrictions that limit the capacity of the classrooms as indicated by the competent public health authorities to the estimated percentage of their usual occupation.

Depending on the capacity of the classroom and the number of students enrolled, it may be necessary to distribute the students into two groups. If this situation arises, each group will attend classroom theory and practical sessions with physical presence in the classroom by rotating shifts, thus ensuring compliance with the criteria for occupying spaces.



The rotation system will be established once the actual enrollment data is known, guaranteeing, in any case, that the attendance percentage of all the students enrolled in the subject is the same.

With respect to laboratory practices, attendance at sessions scheduled in the schedule will be totally face-to-face.

Once the actual enrollment data is available and the availability of spaces is known, the Academic Committee of the Degree will approve the Teaching Model of the Degree and its adaptation to each subject, establishing in said model the specific conditions in which it will be developed teaching the subject.

If there is a closure of the facilities for sanitary reasons that totally or partially affects the classes of the subject, these will be replaced by non-contact sessions following the established schedules.

Evaluation

The evaluation system described in the teaching guide of the subject in which the different evaluable activities have been specified as well as their contribution to the final grade of the subject is maintained.

If there is a closure of the facilities for health reasons that affect the development of any face-to-face evaluable activity of the subject, it will be replaced by a test of a similar nature that will be carried out in virtual mode using the computer tools licensed by the Universitat de València.

The contribution of each evaluable activity to the final grade for the course will remain unchanged, as established in this guide.

Bibliography

The bibliography recommended in the teaching guide.