COURSE DATA

DATA SUBJECT

Code: 34823
Name: Sensors and virtual instrumentation
Cycle: Undergraduate Studies
ECTS Credits: 6
Academic year: 2025-26

STUDY (S)

Degree	Center	Acad. year	Period
1402 - Degree in Telecommunications Electronic Engineering	Escola Tècnica Superior d'Enginyeria	4	Second quarter
1404 - Degree in Industrial Electronic Engineering	Escola Tècnica Superior d'Enginyeria	4	Second quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
1402 - Degree in Telecommunications Electronic Engineering 1404 - Degree in Industrial Electronic Engineering	Optional subjects	ELECTIVES

COORDINATION

RAMIREZ MUÑOZ DIEGO

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.

COMPETENCES / LEARNING OUTCOMES

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 the control of instruments
2. Temperature measurement with linearized thermistor
3. Electric current sensing technologies
4. Introduction to the energy metering monitors
5. Instrumentation system based on the data acquisition card and virtual instrument

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours

Theory	30,00
Laboratory	30,00
Total hours	**60,00**

NON PRESENCIAL ACTIVITIES

Activity	**Hours**
Attendance at other activities	0,00
Individual or group project	24,00
Independent study and work	20,00
Preparation of lessons	34,00
Preparation for assessment activities	12,00
Resolution of case studies	0,00
Total hours	**90,00**

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

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 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 CTaverage.

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

Theory = 0,8 x Proposed design + 0,2 x 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:

Theory = 0.8 x Written exam + 0,2 x CTsaverage

Getting the laboratory mark

Note: Attendance to laboratory classes is compulsory and in anay 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 two following assessments:

1. A mark obtained from the experimental activities and additional questions proposed in each experience (EA), with a wheight 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:

Laboratory = 0,6 x EA + 0,4 x AP

At the **second anouncement**:

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:

Laboratory = 0,4 x PD + 0,6 x 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:

Subject = 0,6 x Theory + 0,4 x 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://www.uv.es/uvweb/universitat/ca/estudis-grau/informacio-academica-administrativa/normatives/normatives-universitat-valencia-1285850677111.html).

Copying or plagiarism of any activity that is part of the evaluation will result in the impossibility of passing the course, and the student will then be subject to the appropriate disciplinary procedures indicated in the ACTION PROTOCOL FOR FRAUDULENT PRACTICES AT THE UNIVERSITY OF VALENCIA (ACGUV 123/2020).

REFERENCES

- Pallàs Areny, R.; "Sensores y acondicionadores de señal". 3ª ed. Marcombo, Barcelona 2001.
- Fraden, J., "AIP Handbook of modern sensors", AIP Press, NY 1993.
- 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.
- Pallàs Areny, Casas O., R. Bragós: ¿Sensores y acondicionadores de señal. Problemas resueltos¿. 3ª ed. Marcombo, Barcelona 2008.
- 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.
- Pallás Areny, R., Webster, J. G.: ¿Sensors and signal conditioning¿, New York : J. Wiley and Sons, c2001, isbn: 9780471332329. Referencia equivalente a la nº [b3] pero en formato electrónico.
- Derenzo, S. E., ¿Practical interfacing in the laboratory using a pc for instrumentation, data analysis, and control¿, Cambridge University Press, Cambridge, 2003, ISBN. 0521815274.
- Morris, Alan S, Measurement and Instrumentation Principles, Jordan Hill: Elsevier Science, 2001, ISBN: 9780080496481 (electronic bk.)
- Sheel, S., author, Instrumentation: theory and applications / S. Sheel, Oxford, U.K: Alpha Science International, [2014], ISBN:9781783320615 (e-book)
- Morris, Alan S., Measurement and instrumentation: theory and application / Alan S. Morris, Reza Langari, Amsterdam: Elsevier, [2016], ISBN: 9780128011324 (e-book)
- 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)