COURSE DATA

Data Subject	
Code	44288
Name	Electronic interfaces for sensors
Cycle	Master's degree
ECTS Credits	3.5
Academic year	2022 - 2023

Study (s)

Degree	Center	Acad. year	Period
2199 - M.D. in Electronic Engineering	School of Engineering	1	First term

Subject-matter

Degree	Subject-matter	Character
2199 - M.D. in Electronic Engineering	3 - Industrial electronic	Obligatory

Coordination

Name	Department
CASANS BERGA, SILVIA	242 - Electronic Engineering

SUMMARY

The purpose of this course is to describe the most common sensing and signal conditioning subsystems as well as the mechanisms of error production in a conventional measurement system and how to reduce them. The topology of a conventional measuring and acquisition system will provide a basis for presenting the concept of smart sensor, their topologies and their processing techniques. From a practical point of view the goal is to gain experience in the use of different types of sensors and electronic interfaces.

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 and circuits.

OUTCOMES

2199 - M.D. in Electronic Engineering

- Students should apply acquired knowledge to solve problems in unfamiliar contexts within their field of study, including multidisciplinary scenarios.
- Students should be able to integrate knowledge and address the complexity of making informed judgments based on incomplete or limited information, including reflections on the social and ethical responsibilities associated with the application of their knowledge and judgments.
- Students should communicate conclusions and underlying knowledge clearly and unambiguously to both specialized and non-specialized audiences.
- Students should demonstrate self-directed learning skills for continued academic growth.
- Take into account the economic and social context in engineering solutions, be aware of diversity and multiculturalism and ensure sustainability and respect for human rights and equality between men and women.
- Diseñar un sistema, componente o proceso que cumpla unas especificaciones desde diferentes puntos de vista: electrónico, económico, social, ético y medioambiental.
- Demostrar una comprensión sistemática de un campo de estudio y el dominio de las habilidades.
- Realizar un análisis crítico, evaluación y síntesis de ideas nuevas y complejas.
- Ser capaz de fomentar, en contextos académicos y profesionales, el avance tecnológico, social o cultural dentro de una sociedad basada en el conocimiento.
- Capacidad para proyectar, calcular y diseñar productos, procesos e instalaciones en todos los ámbitos de la Ingeniería Electrónica y en particular los de tratamiento de la señal, sistemas digitales y de comunicaciones y electrónica industrial.
- Capacidad para el modelado matemático, cálculo y simulación en todos los ámbitos relacionados con la Ingeniería Electrónica y campos multidisciplinares afines. En especial los de tratamiento de la señal, sistemas digitales y de comunicaciones y electrónica industrial.
- Identificar, formular y resolver problemas de los sistemas electrónicos industriales.
- Ability to specify, implement, document and set-up electronics, instrumentation and control equipment and systems, considering both technical aspects and the relevant regulatory requirements.

LEARNING OUTCOMES

- Ability to specify and use electronic instrumentation and measurement systems.
- Be able to perform measurements with electronic equipment relating their limitations to the accuracy of the measurement system.
- Determine which is the contribution to the measurement system accuracy of the different stages considering specifically their actual behaviour.
- Ability to apply appropriate electronic conditioning for a specific measurand using the correct sensor.
- Ser capaz de proponer soluciones válidas a problemas nuevos de sensado y acondicionamiento de señales.
- Be able to propose valid solutions to new sensing problems.

DESCRIPTION OF CONTENTS

1. Variable resistance sensors and conditioners

1.1. Introduction.
1.2. Strain gauges.
1.3. Resistive temperature detectors (RTD).
1.4. Thermistors.
1.5. Signal types.
1.6. Wheatstone bridge.
1.7. Wheatstone bridge post-conditioning.

2. Variable reactance sensors electromagnetic and conditioners.

2.1. Introduction.
2.2. Capacitive sensors.
2.3. Inductive sensors.
2.4. Electromagnetic sensors: Hall effect based sensors.
2.5. AC bridges and amplifiers.
2.6. Carrier amplifiers and coherent detection.

3. Self-generating sensors and their conditioning.

3.1. Introduction.
3.2. Thermoelectric sensors: thermocouples.
3.3. Low offset and drift amplifiers.

4. Conventional measurement systems: Analysis and reduction of errors.

4.1. Introduction.
4.2. Error sources in analog signal processing.
4.3. Error reduction by internal calibration.

5. Smart Sensor: Distribution and applications.

5.1. Smart sensor.
5.2. Smart sensing: distribution and sensing.

6. Mixed techniques processing in intelligent sensors.

6.1. Quasi-digital sensors.
6.2. Direct sensor-to-microcontroller interfacing.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	20,00	100
Laboratory practices	15,00	100
Development of group work	10,00	0
Preparation of evaluation activities	10,50	0
Preparing lectures	10,00	0
Preparation of practical classes and problem	22,00	0
TOTAL	**87,50**	

TEACHING METHODOLOGY

The development of the course is structured around four themes: the theory sessions, problems, tutorials, submision of deliverables and presentation of practices technical documentation.

Group learning with the teacher

In the theory sessions lecture model will be used. In them, the teacher will present the basic content of the course using the audiovisual means available (presentations, transparencies, blackboard). In the practical sessions the teacher will explain a number of problem-type, through which students will learn to identify the essential elements of the approach and problems resolution. Participatory method for these sessions, which are intended to prevail communication between students and students / teacher will also be used. To do this, the teacher previously indicate which day you will devote to solving problems and what problems could be solved, so that the student will attend classes with the approach of these problems prepared in advance. Its resolution will be completed in class in groups of four or five students who must then come to the board to explain the problem and resolve the doubts.

Tutorial time

The students will have a schedule of tutoring aimed to solve the problems, doubts, guidance papers, etc.. The schedule of these tutorials will be indicated in the beginning of the academic year. They will also have the opportunity to clarify some questions via email or discussion forums by using the "Aula Virtual" platform.

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

Laboratory sessions will be organized around groups formed by a maximum of two people who should be planned for the design, installation and tdoing experimental tests. Each practice will consist of two distinct parts. The first part is theoretical and its resolution is required to perform the experimental second part.

Teaching materials

The student will have in the Aula Virtual platform 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 of the course topics.

Problems of each lesson.

Continuous Tests (PECs) of each lesson.

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% respectively. For averaging the ratings of theory and laboratory both must be separately equal or greater than

Getting the theory mark

In both announcements, the theory mark will emerge as a result of:

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

2. As a formative assessment, the student will be able to deliver on the date specified by the teacher the continuous tests (CT). These tests must be sent in PDF format to the teacher before the date indicated. In order to contribute for the final theory mark the average CT value will add to the theory.

The final theory score will be obtained according to the following expression::

Mark Theory =0,6· Written_Exam+0,4·CT avg

Getting the laboratory mark

• The laboratory mark will be the result of a continuous evaluation of all sessions. It will be required to return the activities proposed in the scripts of different practices. The final practice (Mark) Lab corresponds to the weighted average of scores for the session (S) together with those obtained in the delivery of activities (ACT).

The activities will be delivered by groups of two students.

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

$Mark_{Lab} = 0{,}5 \cdot S + 0{,}5 \cdot ACT$

If the student fails the Laboratory or have not followed this on going evaluation (did not attend the lab sessions) he must:

- To submit the lab exercices and designs solved (ACT). They will be the 50% of the working laboratory mark.

- 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 50% of the working laboratory.

Thus, the laboratory score will be obtained by:

Mark =0,5·ACT +0,5·ME Lab

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

$Mark_{Course} = 0{,}5 \cdot Mark_{Theory} + 0{,}5 \cdot Mark_{Laboratory}$

REFERENCES

Basic

- R. Pallás Areny: "Sensores y acondicionadores de señal", 2ª ed. Marcombo, Barcelona 1994.

- R. Pallás Areny, J. G. Webster: "Analog signal processing", Wiley Interscience, NY, 1999.
- Pallás Areny, R.: "Adquisición y distribución de señales". Marcombo, Barcelona 1993.
- R. Pallás Areny, F. Reverter: "Circuitos de interfaz directa sensor microcontrolador", Marcombo, Barcelona, 2008.
- N. V. Kirianaki, S. Y. Yurish, N. O. Shpak, V. P. Deynega:" Data acquisition and signal processing for smart sensors", John Wiley & Sons, NY, 2002.
- S. Sitharama (Ed.), R. R. Brooks (Ed.): "Distributed sensor networks", Chapman & Hall, Boca Raton, 2005.