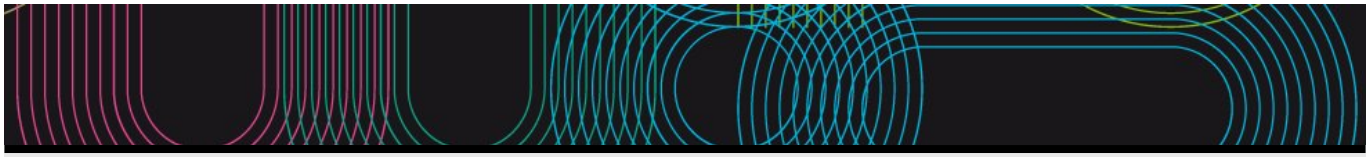

IDENTIFYING DATA				
Signal Conditioners				
Subject	Signal Conditioners			
Code	V05M145V01331			
Study programme	Telecommunication Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	2nd	1st
Teaching language	Spanish			
Department				
Coordinator	Quintáns Graña, Camilo			
Lecturers	Quintáns Graña, Camilo			
E-mail	quintans@uvigo.es			
Web	http://http://faitic.uvigo.es			
General description	In this subject the electronic circuits that condition the signals generated by sensors to be efficiently coupled to a data acquisition system or to a digital processor are studied. It is a subject that follows the Design of Analog Electronic Circuits, which is coursed in the first course of the master. Thus, in this new subject the basic conditioning circuits are expanded by including measuring active bridges, alternating current conditioning circuits, etc. Another important aspect that is included in the study is the evaluation of the measurement uncertainty. Student learns to characterize a measure provided by a sensor through the calibration curve and the uncertainty. The theory is complemented by laboratory practices that focus on providing students with the skills needed to address the realization of a complete measurement system, from the physical system up to the user interface. The key points of the laboratory work are: -The followed methodology to measure physical variables to the calculation of uncertainties. -Characterization of transducers. -Topologies of conditioning circuits. -The connection of the conditioned signals to a digital processor. -Instrumentation software for digitally conditioning and user interfaces.			

Competencies	
Code	
B1	CG1 Ability to project, calculate and design products, processes and facilities in telecommunication engineering areas.
B4	CG4 Capacity for mathematical modeling, calculation and simulation in technological centers and engineering companies, particularly in research, development and innovation tasks in all areas related to Telecommunication Engineering and associated multidisciplinary fields.
B8	CG8 Ability to apply acquired knowledge and to solve problems in new or unfamiliar environments within broader and multidiscipline contexts, being able to integrate knowledge.
C29	CE29/SE2 Ability to build a system of a physical variable measured from the transducer to the user interface, including knowledge of methodology, basic topologies of conditioning signal and instrumentation software

Learning outcomes	
Expected results from this subject	Training and Learning Results
To know the modeling and simulationing of analogic electronic systems by means of the hardware description language SPICE.	B1 B4 B8 C29
To know the evaluationing of the uncertainties in the measuring processes following the standards.	B4
To know how to handle and to program data acquisition systems.	B1 C29

To know the developing of complex electronic circuits for conditioning the sensors.	B1 B4 B8 C29
To konw to analyse and to design circuits for interfaces between the sensors and digital processors.	B1 C29
To know how to develop an instrumentation electronic systems.	B1 B4 B8 C29

Contents	
Topic	
Unit 1: Introduction to the measuring systems of physical variables.	Functional and working characteristics of sensors. Evaluation of measurement data. Sensor calibration. Measurement uncertainties. Parts of a conditioning circuit. Types of conditioners.
Unit 2: Introduction to the metrology. Evaluation of measurement uncertainty.	Methodology to measure and to calibrate sensors. Terminology. Statistical method.
Unit 3. Circuits to conditioning signal from measured sensors.	Active measuring bridges in direct and alternating current. Ac/dc converters. Selection and design of filtering stages. Frequency to voltage converters. Conditioners for output stages.
Unit 4: Interfaces between on-off sensors and digital processors.	Basic concepts of local interfaces of on-off sensors. Interfaces with and without galvanic isolation. Coupling in alternating and continuous current.
Unit 5: Conditioning circuits for inductive and magnetic measure sensors.	Study of the conditioners for several inductive and magnetic sensors according to his application.
Unit 6: Conditioning circuits for capacitive measureing sensors.	Study of the conditioners for capacitive sensors.
Unit 7: Conditioning circuits for generators sensors.	Study of the conditioning circuits for generators sensors according to his physical working principle.
Unit 8: Practical cases of conditioning circuits for measuring sensors.	Study of real cases with commercial sensors and circuits.

Planning			
	Class hours	Hours outside the classroom	Total hours
Laboratory practises	7	14	21
Tutored works	5	25	30
Master Session	13	26	39
Reports / memories of practice	1	10	11
Practical tests, real task execution and / or simulated.	2	10	12
Short answer tests	1	5	6
Troubleshooting and / or exercises	1	5	6
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Laboratory practises	Application, at a practical level, of the knowledge and skills acquired in the lectures by mean of practices undertaken with test and measurement equipment, either in the laboratory or in other place.
Tutored works	The student, of individual way or in group, elaborates a document on the thematic of the matter or prepares seminars, investigations, memories, essays, summaries of reading, conferences, etc.
Master Session	Exhibition of the contents of the subject; it includes exhibition of concepts; introduction of practices and exercises; and resolution of problems and/or exercises in ordinary classroom.

Personalized attention	
Methodologies	**Description**
Master Session	The professor will attend personally doubts and queries of the students on the study of the theoretical concepts and the exercises. The tutorships will do in the office of the professor in the schedule that establish at the beginning of the course and that will publish in the page Web of the subject.

Laboratory practises	The professor will attend personally doubts and queries of the students on the preparation of the practices of laboratory. The tutorships will do in the office of the professor in the schedule that establish at the beginning of the course and that will publish in the page Web of the subject.
Tutored works	The professor will attend personally doubts and queries of the students on the upervised works. The tutorships will do in the office of the professor in the schedule that establish at the beginning of the course and that will publish in the page Web of the subject.

Tests	**Description**
Reports / memories of practice	The professor will attend personally doubts and queries of the students on the preparation and presentation of the memories of the results of the laboratory practices. The tutorships will do in the office of the professor in the schedule that establish at the beginning of the course and that will publish in the page Web of the subject.

Assessment

	Description	Qualification	Training and Learning Results
Laboratory practises	It values the participation of the student in the practices of laboratory: preparation of previous tasks, fulfillment of the aims posed in each practice and back tasks in which the student analyses the results, compares them with the expected and presents the conclusions. They can apply to the tests of continuous or final assessment.	15	B1 B4 B8 C29
Tutored works	The student, individually or in group, elaborates a document on the thematic of the matter or prepares seminars, investigations, memories, essays, summaries of reading, conferences, etc.	10	B1 C29
Reports / memories of practice	Preparation of a document by part of the student in which they reflect the characteristics of the work carried out. The students have to describe the tasks and procedures developed, show the results obtained and observations realised, as well as the analysis and treatment of data.	15	B1 B4 B8 C29
Practical tests, real task execution and / or simulated.	Tests that include activities of laboratory and/or TIC, problems or cases to resolve. The students have to give answer to the activity formulated by reflecting, in a practical way, the theoretical and practical knowledge that have been learnt in the subject, using, if it is necessary, the equipment or instrumentation of the practices carried out in the course. They can apply to the tests of continuous or final assessment.	20	B1 B4 B8 C29
Short answer tests	Tests that include direct questions about an specific topic. The student has to answer of direct form in virtue of the knowledges that has on the subject. The answer is brief. They can apply to the tests of continuous evaluation or to the final examination.	20	B1 B4 C29
Troubleshooting and / or exercises	Proof in which the student has to solve a series of problems and/or exercises in a time/condition established/ace by the professor. Of this form, the student has to apply the knowledges that purchased. The application of this technique can be face-to-face or not. You can use different tools to apply this technique as, for example, chat, run or forum, audio, video, etc.	20	B1 B4 B8 C29

Other comments on the Evaluation

1. Continuous evaluation

The practical part (50% of the note) and the part of theory (50% of the note) are evaluated by continuous assessment. Each one of these parts are evaluated following the methodologies described before with his respective weights in the following way:

-Practical part: it is divided in the progress of the practices in the laboratory (15%), the report of practices (15%) and a practical exam (20%).

-Part of theory: it is divided in one exam with questions of short answer (20%), the supervised work (10%) and the exam with resolution of problems (20%).

The final mark, which is on a maximum of 10 points, is the sum of the notes of each part, if the students fulfill the following conditions:

-Have carried out a minimum of 80% of the laboratory practices.

-Obtain a minimum mark of 40% in each one of the two parts of the evaluation (theory and practice).

If it does not fulfill some of the previous requirements, the final mark will be the sum of the notes of each part, but limited to 40% of the maximum mark (4 points).

To pass, the students have to obtain an equal total mark or upper to the 50% of the maximum mark (5 points).

The practical test will take place in the last session of the laboratory classes. The tests of resolution of problems and of short answer can be divided in two sessions spread along the period of teaching.

The reports of the supervised work and of the practices have to be delivered before finalizing the period of final exams established for the term.

The assessment is particular for each student and the practices of laboratory will be done preferably by individual form. If it is the case, the marks of the activities that the students do in groups will be the same for all the students that compose it.

2. Final exam

The students that do not opt by the continuous evaluation (have not carried out, at least, 80% of the practices) or have obtained a total mark below 5 (suspense), will be able to do to the final exam.

The final exam will consist of a practical exam at the laboratory and in an exam of theory with questions of short answer and resolution of problems, each one corresponding to 50% of the total mark. To pass the student must obtain a minimum of 40% in each part and sum in total, at least, 5 points.

3. Call for recovery

The call for recovery will be like the final exam.

Sources of information

Basic Bibliography

Pallás Areny, Ramón, **Sensors and signal conditioning**, Second Edition, John Wiley & Sons, inc., 2001

European co-operation for Accreditation, **Expression of the Uncertainty of Measurement in Calibration**, September 2013 rev 02, EA-4/02 M, 2013

Complementary Bibliography

Philip R. Bevington and D. Keith Robinson, **Data Reduction and Error Analysis for the Physical Sciences**, McGraw Hill, 2003

Grupo de Trabajo 1 del Comité Conjunto de Guías en Metrología (JCGM / WG 1), **Guía para la Expresión de la Incertidumbre de Medida**, 2008

C. Quintáns, **Simulación de Circuitos Electrónicos con OrCAD 16 DEMO**, 1, Marcombo, 2008

Recommendations

Subjects that it is recommended to have taken before

Digital and Analog Mixed Circuits/V05M145V01213
Analog Electronic Circuits Design/V05M145V01106
Advanced Digital Electronic Systems/V05M145V01203