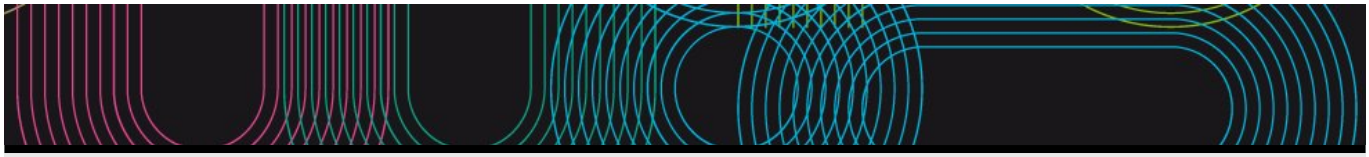

IDENTIFYING DATA				
Data Acquisition Systems				
Subject	Data Acquisition Systems			
Code	V05G301V01314			
Study programme	Degree in Telecommunications Technologies Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	3rd	2nd
Teaching language	Spanish Galician			
Department				
Coordinator	Poza González, Francisco			
Lecturers	Eguizábal Gándara, Luis Eduardo Machado Domínguez, Fernando Poza González, Francisco			
E-mail	fpoza@uvigo.es			
Web	http://www.faitic.uvigo.es			
General description	This subject is about acquisition data, including instrumention amplifiers, analog switches, active filters, S&H and converters.			

Competencies	
Code	
C43	(CE43/SE5): The ability to design analogical and digital electronics circuits of analogical to digital conversion and vice versa, of radiofrequency, of feeding and electrical energy conversion for computing and telecommunication engineering.
C45	(CE45/SE7): The ability to design interface, data capturing and storage devices, and terminals for services and telecommunication systems.

Learning outcomes	
Expected results from this subject	Training and Learning Results
Knowledge of instrumentation amplifiers, and control about its use.	C43 C45
Knowledge of the different types of electronic analogue switches and the control of applications.	C43 C45
Knowledge of Sample&Hold circuits and their applications in data acquisition.	C43 C45
Knowledge of the operation of different DAC and ADC converters, and the control of their applications.	C43 C45
Knowledge about data storage and the control of their applications.	C43 C45
Knowledge of the design of data acquisition using the previous elements.	C43 C45

Contents	
Topic	
Unit 1. Introduction to data acquisition systems (DAS)	1.1. Introduction 1.2. Components of DAS 1.3. Control systems
Unit 2. Auxiliary circuits	2.1. Level shifter circuits 2.2. Voltage reference 2.3. Voltage-to-current converters

Unit 3. Analog switches and multiplexers	3.1. Analog switches 3.2. Analog multiplexers
Unit 4. Amplification in data acquisition	4.1. Instrumentation amplifiers 4.2. Programmable gain amplifiers 4.3. Isolation amplifiers
Unit 5. Active filters	5.1. Introduction 5.2. First and second order transfer functions 5.3. Transfer functions aproximation 5.4. Active filters synthesis
Unit 6. Sample and hold circuits	6.1. Introduction 6.2. Base circuit 6.3. Practical architectures 6.4. Real parameters 6.5. Commercial devices
Unit 7. Digital-to-analog and analog-to-digital converters	7.1 Digital-to-analog converters (DAC) 7.1.1. Introduction 7.1.2. Transfer function 7.1.3. Parameters and errors 7.1.4. Classification 7.1.5. DAC architectures 7.2. Analog-to-digital converters (ADC) 7.2.1. Introduction 7.2.2. Transfer function 7.2.3. Parameters and errors 7.2.4. Classification 7.2.5. ADC architectures
Practice 0. Introduction	Introduction to laboratory concepts and tools.
Practice 1. Auxiliary circuits	Experimental test and analysis of auxiliary circuits used in signal conditioning stages.
Practice 2. Instrumentation amplifier	Experimental test and analysis of instrumentation amplifiers.
Practice 3. Isolation amplifier	Experimental test and analysis of linear optical isolation amplifiers built from discrete components.
Practice 4. Active filters	Experimental test and analysis of active filter topologies.
Practice 5. Digital-to-analog conversion	Experimental test and analysis of a digital-to-analog converter (DAC) built from discrete components.
Practice 6. Analog-to-digital conversion	Experimental test and analysis of an analog-to-digital converter (ADC) based on an ADC integrated circuit.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	14	37.5	51.5
Problem solving	4	22.5	26.5
Laboratory practical	14	28	42
Mentored work	7	20	27
Problem and/or exercise solving	3	0	3

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies

	Description
Lecturing	The lecturer will show some theoretical contents related to the subject. Competencies CE43 and CE45 will be addressed in these sessions.
Problem solving	The lecturer will solve some exercises related to the subject. Competencies CE43 and CE45 will be addressed in these sessions.
Laboratory practical	Simulations and real assembled circuits will be tested. Competencies CE43 and CE45 will be addressed in these sessions.
Mentored work	The lecturer will lead the students in a data acquisition system design. Competencies CE43 and CE45 will be addressed in these sessions.

Personalized assistance

Methodologies	Description
Lecturing	The teacher will resolve the doubts of the students in his office at the schedule established and published on the school website.
Problem solving	The teacher will resolve the doubts of the students in his office at the schedule established and published on the school website.

Mentored work	The teacher will resolve the doubts of the students in his office at the schedule established and published on the school website.
Laboratory practical	The teacher will resolve the doubts of the students in his office at the schedule established and published on the school website.

Assessment			
	Description	Qualification	Training and Learning Results
Laboratory practical	The lecturer will check the level of compliance of the students with the goals related to the laboratory skills. The final mark of laboratory, FML, will be assessed in a 10 points scale. For the evaluation of the laboratory sessions, the lecturer will assess the group work (the same mark for each member), the individual preliminary tasks and the answers to personalized questions for each session.	30	C43 C45
Mentored work	The lecturer will consider the results and the quality of the analysis performed in the developed work. The tutored work mark, TWM, will be assessed in a 10 points scale. For the evaluation of the work, the lecturer will assess the group work (the same mark for each member) and the individual answers to personalized questions (individual mark).	20	C43 C45
Problem and/or exercise solving	The lecturer will check the level of compliance of the students with the goals related to the theory skills. To achieve this three exercises and troubleshooting tests are scheduled. The final mark of theory, FMT, will be assessed in a 10 points scale.	50	C43 C45

Other comments on the Evaluation

1. Continuous assessment in first call

According to the guidelines of the degree and the agreements of the academic commission, a continuous assessment learning scheme will be offered to the students.

When the students perform a short answer test or attend at least two laboratory sessions, ***they will be assessed by continuous assessment***.

The subject comprises three different parts: theory (50 %), laboratory (30%) and tutored work (20%). Once a task has been assessed, the students can not do/repeat the task at a later date. The marks are valid only for the current academic course.

1.a Theory

Three exercises and troubleshooting tests are scheduled. The exercises and troubleshooting tests (ETT1, ETT2 and ETT3) will be respectively performed after unit 4, 5 and 7, in the usual weekly scheduling of the theoretical classes. The first test (ETT1) of the themes 1 to 4, the second test (ETT2) of the theme 5 and third test (ETT3) of the themes 6 and 7.These tests are approximately 60 minutes long.

Marks for each test will be assessed in a 10 points scale. The minimum mark required to pass this part is of 4 (ETTi>=4). The final mark of theory (FMT) is calculated as the arithmetic mean of the individual marks:

FMT = (ETT1 + ETT2 + ETT3)/3

The students cannot do the tests at a later date. The student who miss a test will be assessed with a mark of 0 for that test.

If the minimum mark in the tests is not achieved (ETTi less than 4), the students can repeat this part in the same date of the final exam.

1.b Laboratory

Seven laboratory sessions are scheduled. Each session lasts approximately 120 minutes and the students will work in pairs. The first session is mandatory but will not be assessed. The following seasons (practice 1 to 6) will be assessed by continuous assessment. The lecturer will consider the proposed individual tasks, the work in the laboratory as well as the student□s behavior. Each session will be only evaluated according to the developed work at the schedule date.

Marks for each laboratory session (LSM) will be assessed in a 10 points scale. A mark of 0 will be obtained for missing sessions. The final mark of laboratory (FML) is calculated as the arithmetic mean of the individual laboratory session marks:

FML = (LSM1 + LSM2 + LSM3 + LSM4 + LSM5 + LSM6)/6

1.c Tutored work

In the first session lecturer will present the objectives and the schedule of the project. They also assign a specific project to each group. The students will work in pairs whenever possible.

In order to assess the work, the lecturer will consider the results, their analysis and presentation, and the quality of the written report. The tutored work mark (TWM) will be assessed in a 10 points scale.

1.d Final mark of the subject

The weighted points from all assessed parts are added together to calculate the final mark (FM). The following weightings will be applied: 50% theory (FMT), 30% laboratory (FML) and 20% tutored work (TWM). In order to pass the subject, students will be required to pass the theory (ETT1>=4, ETT2>=4 , ETT3>=4 and FMT>=5), the laboratory (FML >= 5) and the tutored work (TWM >= 5). In this case the final mark (FM) will be:

FM = 0.5·FMT + 0.3·FML + 0.2 TWM.

However, when the students do not pass the theory (ETT1 < 4, ETT2 < 4 , ETT3 < 4 or FMT < 5), the laboratory (FML < 5) or the tutored work (TWM < 5), the final mark will be:

FM = min{4 ; (0.5·FMT + 0.3·FML + 0.2 TWM)}.

A final mark higher than five points (FM >= 5) should be achieved in order to pass the subject.

2. Exam-only assessment (first call)

The students who prefer a different educational policy can attend an exam on a scheduled date and deliver a tutored work the same date. Dates will be specified in the academic calendar. This exam will comprise two parts: theory and laboratory exam.

The theory exam will consist on three exercises and troubleshooting tests (ETT1, ETT2 and ETT3): the first test of the themes 1 to 4, the second test of the theme 5 and third test of the themes 6 and 7. These tests are approximately 60 minutes long. Marks for each test will be assessed in a 10 points scale. The minimum mark required to pass this part is of 4 (ETTi>=4). The final mark of theory (FMT) is calculated as the arithmetic mean of the individual marks:

FMT = (ETT1 + ETT2 + ETT3)/3

The laboratory exam will consist on the resolution of a practical exercise in the laboratory. This practical exercise will be similar to those made in the laboratory sessions. The final mark of laboratory (FML) will be assessed in a 10 points scale. In order to attend the laboratory exam, the students have to contact to the lecturer at least two weeks before the exam. This way, the organization of the laboratory exam will be simpler.

In order to pass the subject, students will be required to pass the theory (ETT1>=4, ETT2>=4 , ETT3>=4 and FMT>=5), the laboratory (FML >= 5) and the tutored work (TWM >= 5). In this case the final mark (FM) will be:

FM = 0.5·FMT + 0.3·FML + 0.2·TWM).

However, when the students do not pass the theory (ETT1 < 4, ETT2 < 4 , ETT3 < 4 or FMT < 5), the laboratory (FML < 5) and the tutored work (TWM < 5), the final mark will be:

FM = min{4 ; (0.5·FMT + 0.3·FML + 0.2·TWM)}.

A final mark higher than five points (FM >= 5) should be achieved in order to pass the subject.

3. Second call and end-of-program call

This exam will have the same format as the exam-only assessment (first chance). Dates will be specified in the academic calendar. In order to attend the laboratory exam, the students have to contact to the lecturer at least two weeks before the exam. This way, the organization of the laboratory exam will be simpler. The same day of this exam the students will deliver the tutored work, assigned previously.

The marks obtained in the previous assessments are kept for those parts in which the student has not attended. The final mark will be calculated as it has described in section 1.d for students in continuous assessment in first call and in section 2 for students in exam-only assessment (first call).

Sources of information

Basic Bibliography

Paul Horowitz y Winfield Hill, **The Art of Electronics**, Cambridge Univ. Press.,
Sergio Franco, **Design with Operational Amplifiers and Analog Integrated Circuits**, WCB/McGraw-Hill,
Franco Maloberti, **Data Converters**, ISBN 978-0-387-32485-2,

Complementary Bibliography

Analog Devices Library,
hhtp;//www.analog.com/library/analogDialogue/archives/43-09/EDCh%206%20Converter.pdf, Capitulos 6.1,6.2,6.3,

Recommendations

Subjects that continue the syllabus

Analogue Electronics/V05G301V01311

Subjects that are recommended to be taken simultaneously

Analogue Electronics/V05G301V01311

Subjects that it is recommended to have taken before

Digital electronics/V05G301V01203
Electronic technology/V05G301V01206

Other comments

I recommend the students to search the web for information about this subject. Electronic devices factories show interesting information. Many universities around the world hung interesting notes in the Internet. And many of them for free.

Contingency plan

Description

In case of online tuition, then the planning and the evaluation will be carried out as follows:

* Theory: the theory classes will be performed through electronic means and the contents will be available online.

* Practices: depending on the contents developed in each laboratory practice and the availability of material, the session will be performed in a virtual way, in the students home (using provided basic equipment) or by simulation (using free software or University licensed software). The details of each practices session will be available online in FAITIC. In this scenario, the practices will be individually developed and evaluated.

* Project: depending on the proposed project and the availability of material, the work will be performed in a virtual way, in the students home (using provided basic equipment) or by simulation (using free software or University licensed software). The details of each project session will be available online in FAITIC. In this scenario, the project will be individually developed and evaluated.

* Assessment: the assessment will supported by FAITIC and Campus Remoto.