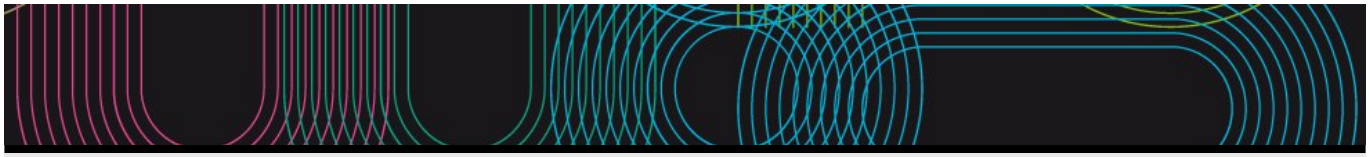

IDENTIFYING DATA				
Data Acquisition Systems				
Subject	Data Acquisition Systems			
Code	V05G301V01314			
Study programme	Grado en Ingeniería de Tecnologías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	3rd	2nd
Teaching language	Spanish Galician			
Department				
Coordinator	Poza González, Francisco			
Lecturers	Poza González, Francisco			
E-mail	fpoza@uvigo.es			
Web	http://moovi.uvigo.gal			
General description	This subject is about data acquisition, including instrumention amplifiers, analog switches, active filters, S&H and converters.			

Training and Learning Results	
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.

Expected results from this subject	Training and Learning Results
Knowledge of instrumentation amplifiers, and control about its use.	C43 C45
Knowledge of the different topologies of active filters.	C43 C45
Knowledge of the different types of electronic analog switches, and control about its use.	C43 C45
Knowledge of Sample&Hold circuits and their applications in data acquisition.	C43 C45
Knowledge of the operation of different D/A and A/D converters, and control about its use.	C43 C45
Knowledge of the design of data acquisition systems 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	1	0	1
Problem and/or exercise solving	1	0	1
Problem and/or exercise solving	1	0	1

*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. Competences C43 and C45 will be addressed in these sessions.
Problem solving	The lecturer will solve some exercises related to the subject. Competences C43 and C45 will be addressed in these sessions.
Laboratory practical	Simulations and real assembled circuits will be tested. Software to be used: LabVIEW and Multisim from National Instruments Competences C43 and C45 will be addressed in these sessions.
Mentored work	The lecturer will lead the students in a data acquisition system design. Competences C43 and C45 will be addressed in these sessions.

Personalized assistance

Methodologies	Description
Lecturing	In the classes the doubts of the students will be answered. They will also be able to consult with the teacher in the place and at the time published at https://moovi.uvigo.gal/user/profile.php?id=11302.

Problem solving	In the classes the doubts of the students will be answered. They will also be able to consult with the teacher in the place and at the time published at https://moovi.uvigo.gal/user/profile.php?id=11302.
Mentored work	In the classes the doubts of the students will be answered. They will also be able to consult with the teacher in the place and at the time published at https://moovi.uvigo.gal/user/profile.php?id=11302.
Laboratory practical	In the classes the doubts of the students will be answered. They will also be able to consult with the teacher in the place and at the time published at https://moovi.uvigo.gal/user/profile.php?id=11302.

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	First partial theory test. The lecturer will check the level of compliance of the students with the goals related to the theory skills. The final mark will be assessed in a 10 points scale.	16.66	C43 C45
Problem and/or exercise solving	Second partial theory test. The lecturer will check the level of compliance of the students with the goals related to the theory skills. The final mark will be assessed in a 10 points scale.	16.66	C43 C45
Problem and/or exercise solving	Third partial theory test. The lecturer will check the level of compliance of the students with the goals related to the theory skills. The final mark will be assessed in a 10 points scale.	16.66	C43 C45

Other comments on the Evaluation

1. Continuous assessment in ordinary exam

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.

It is considered that all the students have chosen continuous assessment by default.

Choosing of global assessment must be communicated in writing form to the coordinator within one month of the start of the semester.

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.

Plagiarism is regarded as serious dishonest behavior. If any form of plagiarism is detected in any of the tests or exams, the final grade will be FAIL (0), and the incident will be reported to the corresponding academic authorities for prosecution.

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

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{4.9 ; (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.

If the students who are following continuous assessment deliver all the tasks, the mark of the part of the subject (theory, laboratory and tutored work) in which they have obtained the minimum demanded will be preserved, only until the extraordinary exam of the same academic course.

2. Global assessment (ordinary and extraordinary exam) and end-of-program exam

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{4.9 ; (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.

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 are recommended to be taken simultaneously

Electronic Instrumentation and Sensors/V05G301V01316

Subjects that it is recommended to have taken before

Digital electronics/V05G301V01203
Analogue Electronics/V05G301V01311

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.