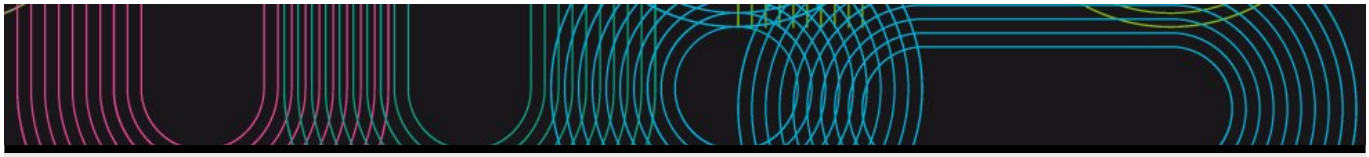

IDENTIFYING DATA				
Digital and Analog Mixed Circuits				
Subject	Digital and Analog Mixed Circuits			
Code	V05M145V01213			
Study programme	Telecommunication Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	1st	2nd
Teaching language	Spanish			
Department				
Coordinator	Quintáns Graña, Camilo			
Lecturers	Quintáns Graña, Camilo			
E-mail	quintans@uvigo.es			
Web	http://faitic.uvigo.es			
General description	The majority of the electronic systems are a mixture of analogic and digital circuits. Due to this fact, besides studying them separately, it is necessary to consider them as a whole and to know their specific characteristics. From a point of view of the electrical signal, the mixed circuits can use both digital signals with analogic information and analogic signals with digital information. Combining the digital data domain with the analogic and temporal is of fundamental importance for designing complex systems. This subject introduces the students in the multidisciplinary study of the different kind of circuits which conform the electronic systems.			

Competencies	
Code	
A1	CB1 Knowledge and understanding needed to provide a basis or opportunity for being original in developing and/or applying ideas, often within a research context.
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.
C11	CE11 Knowledge of hardware description languages for high complexity circuits.
C12	CE12 Ability to use programmable logic devices, as well as to design advanced electronic systems, both analog and digital. The ability to design communications components such as routers, switches, hubs, transmitters and receivers in different bands.
C14	CE14 Ability to develop electronic instrumentation, as well as transducers, actuators and sensors.

Learning outcomes	
Expected results from this subject	Training and Learning Results
To know and to understand the basics of mixed circuits in order to obtain new applications that combine different methods and resources for the design of complex systems	A1
- Internilize knowledge fostering attitudes and skills to help to compete in a global environmet. - Applying the knowledges through conceptual integration, and via the analysis and the practical application. - Develop a suitable methodology for the diagnostic, the generation of alternatives and the election of options for the internationalisation of companies, organisations or projects. - Identifying correct decisions in a business context. - Favouring the implication in the preparation of internationalization projects or developing any already existent. - Stimulate the entrepreneurial attitude in internationalization projects.	

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To know the modeling of mixed electronic systems by using the mathematical basis of the continuous analog systems and discrete systems.	B4
The ability to combine different methods and resources for the design of complex systems that include analog and digital circuits.	B8
The knowledge of the characteristics of the description languages modeling the analog and digital mixed electronic circuits. To be able of modeling mixed electronic systems using hardware description languages.	C11
Knowing how to combine different methods and resources for the design of complex systems that include analog and digital circuits. To design matching circuits from analog to digital signal processors efficiently. Besides of the output signals from analog systems to digital processors.	C12
To know how to design specific digital filters and modulators for sampling and reconstruction of signals. To know how to use the modulation techniques for conditioning of sensors and for generating electrical signals to actuators.	C14

Contents

Topic	
Unit 1: Introduction to mixed analog and digital electronic circuits.	Mixed circuits characteristics. Modeling, simulation and applications of mixed circuits. Introduction to hardware description languages for analog / digital mixed circuits.
Unit 2: Introduction to direct signal coupling techniques from analog to digital processors.	Introduction. Coupling technology in base band and by modulation. Measurement of time constants. PWM modulation. Sigma-Delta Modulation. Phase modulation. Frequency Modulation. Resources for coupling analog signals to digital processors.
Unit 3: Oversampling Techniques for digital processing of analog signals.	Oversampling techniques. Resolution gain. Reshaping of the quantization noise spectrum. First-order modulator. Modeling, simulation and test of sigma-delta modulators.
Unit 4: Sigma-delta modulators circuits.	Design of sigma-delta modulators with different topologies. Operating parameters. Low-pass and band-pass modulators.
Unit 5: Introduction to multistage A/D converters.	Pipelined A/D converters. Basic steps, timing and alignment. Test methods.
Unit 6: Digital filter circuits for signal sampling and reconstruction applications.	VHDL synthesis of digital filters. Decimation filters. Equalizer filters. Data format. Optimization.
Unit 7: Digital synthesis of signals to feed analog systems.	Methods of digital synthesis of analog signals. Direct synthesis. IIR filters. Modeling of digital synthesizers of analog signals with hardware description languages.
Unit 8: Applications of the mixed electronic circuits.	Modelling and implementation of mixed circuits with high level design tools.

Planning

	Class hours	Hours outside the classroom	Total hours
Introductory activities	0.5	1	1.5
Lecturing	10.5	21	31.5
Mentored work	4.5	9	13.5
Problem solving	2	4	6
Laboratory practical	7.5	15	22.5
Laboratory practice	1	11	12
Essay	0.5	1	1.5
Essay questions exam	1	15	16
Problem and/or exercise solving	1	15	16
Systematic observation	1	1	2
Report of practices, practicum and external practices	0.5	2	2.5

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

Methodologies

	Description

Introductory activities	Activities aimed at making contact and gathering information about the students, as well as presenting the subject.
Lecturing	Exhibition by the teacher of the reports on the subject matter of study, theoretical bases and / or guidelines of a work, exercise that the student has to develop.
Mentored work	The student, individually or as a group, carries out activities, which can be: - Monographic works, search of information in publications, databases, articles, books ... on a specific topic. - Preparation of seminars, research, reports, essays, conferences, etc. - Reviews on current scientific articles. - Projects (design and develop projects).
Problem solving	Activity in which problems and / or exercises related to the subject are formulated. The student must develop the correct solutions through the exercise of routines, and application of formulas or algorithms, the application of procedures of transformation of the available information and the interpretation of the results.
Laboratory practical	Activities of application of knowledge and concrete situations, and acquisition of basic and procedural skills, related to the object of study. They are developed in special spaces with specialized equipment (laboratories, computer rooms, etc.).

Personalized assistance

Methodologies	Description
Lecturing	The professor will attend personally doubts and queries of the students on the study of the theoretical concepts and 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 practical	The professor will attend personally doubts and queries of the students to prepare 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.
Mentored work	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.
Problem solving	The professor will attend personally doubts and queries of the students on the resolution of the problems. 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**
Report of practices, practicum and external practices	The professor will attend personally doubts and queries of the students on the preparation of the report of 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 practice	Execution practices of real or simulated tasks. These are tests in which the performance of the students will be evaluated on the basis of the knowledge shown, the behavior, organization and planning during the practice, reflection on the results obtained, etc.	20		B8	C11 C12 C14
Essay	It is a text prepared on a topic and should be written following established rules.	10	A1	B4 B8	
Essay questions exam	Tests that include open questions about a topic. Students must develop, relate, organize and present the knowledge they have about the subject in an extensive response.	20		B4 B8	C11 C12 C14
Problem and/or exercise solving	Test in which the student must solve a series of problems and / or exercises in a time / conditions established by the teacher. In this way, students must apply the knowledge acquired.	25	A1	B4 B8	C11 C12 C14
Systematic observation	Attentive, rational, planned and systematic perception to describe and record the manifestations of student behavior.	10		B8	
Report of practices, practicum and external practices	Preparation of a report by the student in which the characteristics of the work carried out are reflected.	15		B8	C11 C12

Other comments on the Evaluation

1. First call: Continuous assessment

The continuous evaluation consists of the following four parts:

1.-Laboratory (35%), which is divided into:

Development of laboratory practices: Monitoring (10%) plus the practical test (10%).

Report of laboratory practices (15%).

2.-Theory exams (45%), which is divided in an orientation way in:

Development questions (20%).

Problems (25%).

3.-Tutored work (10%), in which the results will be presented in a report of the C group.

4.-Systematic observation (10%). In addition to the aspects mentioned in the description, the participation of the student in carrying out the activities proposed for their autonomous work and the use of personalized attention in the office hours of the teacher will be taken into account.

The final grade, which is scored on a maximum of 10 points, is the sum of the mark of each part if the following conditions are met:

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

2.-Obtain a minimum mark of the 40% in each part of the assessment.

If it does not fulfill any of the previous requirements, the final mark will be the sum of the marks of each part, but limited to the 40% of the maximum note (4 points). Students who do not reach a minimum score of 40% in the laboratory evaluation, exams and supervised work in the continuous assessment may recover them in the second opportunity tests while maintaining the percentages of the continuous assessment.

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 near of the last session of laboratory classes. The development questions and problems will can be divided in two sessions spread along the period of teaching.

2. First call: Final exam

Students who fail the course in continuous assessment (have not performed, at least, 80% of the practices) can will take a final exam.

The final exam will consist of a practical and a theoretical test, each corresponding to 50% of the total mark. To pass the student must obtain at least the 40% in each part and must sum a total of at least 5 points.

The students of continuous evaluation that have pending to surpass the minimum of some part will be able to do it in the final examination. If they did not reach the minimum in the supervised work, they will have a deadline to present the proposed improvements until the final exam.

3. Second call

In the second call the assessment will be like the final exam of the first call.

Sources of information
Basic Bibliography
R. Schreier y G.C. Temes, **Understanding Delta-Sigma Data Converters**, IEEE Press, John Wiley & Sons, Inc., 2005
U. Meyer-Base, **Digital Signal Processing with Fiel Programmable Gate Arrays**, 4, Springer, 2014
Charles H. Roth, Lizy Kurian John, **Digital Systems Design using VHDL**, 3, Cengage Learning, 2017
F. Maloberti, **Data Converters**, Springer, 2008
Complementary Bibliography
C. Quintáns, **Simulación de Circuitos Electrónicos con OrCAD 16 DEMO**, 1, Marcombo, 2008
Steven W. Smith, **The Scientist and Engineer□s Guide to Digital Signal Processing**, California Technical Publishing, 1997
G.I. Bourdopoulos, et al, **Delta-Sigma modulators : modeling, design and applications**, Imperial College Press, 2003
S. J. Orfanidis, **Introduction to signal Processing**, Prentice Hall International, Inc., 1997
Alfi Moscovici, **High Speed A/D Converters: Understanding Data Converters Through SPICE**, Kluwer Academic Publishers, 2006

Libin Yao, Michel Steyaert and Willy Sansen, **Low-Power Low-Voltage Sigma-Delta Modulators in nanometer CMOS**, Springer, 2006

Recommendations

Subjects that continue the syllabus

Signal Conditioners/V05M145V01331

Subjects that are recommended to be taken simultaneously

Advanced Digital Electronic Systems/V05M145V01203

Subjects that it is recommended to have taken before

Analog Electronic Circuits Design/V05M145V01106

Contingency plan

Description

In the case to happen to a stage of teaching totally no face-to-face will apply the following extraordinary measures:

Theory
The contents and his distribution in the distinct parts will keep independently of the format of teaching, face-to-face or no face-to-face.

Laboratory
In this part of laboratory, all the practices will make using a simulator of electronic circuits (available in version of free access), except those that require of the use of instrumentation and specific equipment. In case that along the period of teaching alternate with situations of face-to-face teaching and no face-to-face, will be able to adapt the planning as far as possible to carry out in the laboratory those practices that require of the use of instrumentation and specific equipment.

Documentation and bibliography
As in the situation of normal conditions, the no face-to-face teaching will base in the documentation and other didactic resources that the educational team will put to disposal of the students in the FAITIC platform of the University and of the available basic bibliography in the library.

Evaluation
The contents and the distribution of marks in the evaluation, in both continuous and final, will keep independently of the format of teaching, face-to-face or no face-to-face.
As in the no face-to-face teaching, the objective acts of assessment will carry out in a synchronous way and using the remote available tools in CAMPUS REMOTO and FAITIC. In the practical part will be used the same platform and, moreover, the same free access simulator used in the practices.