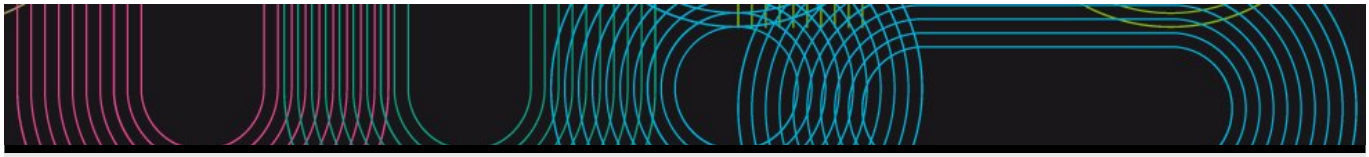

IDENTIFYING DATA				
Analogue Electronics				
Subject	Analogue Electronics			
Code	V05G306V01311			
Study programme	Bachelor Degree in Telecommunication Technologies Engineering (BTTE)			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	3rd	1st
Teaching language	#EnglishFriendly Spanish			
Department				
Coordinator	Raña García, Herminio José			
Lecturers	Quintáns Graña, Camilo Raña García, Herminio José			
E-mail	hrana@uvigo.es			
Web	http://moovi.uvigo.gal			
General description	This subject studies the feedback concept, and its applications to amplifiers. The opamps and their applications are also studied. English Friendly subject: International students may request from the teachers: a) materials and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

Training and Learning Results	
Code	
C42	(CE42/SE4): The ability to apply electronics as support technology in other fields and activities and not only in information and communication technologies.
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.
C44	(CE44/SE6): The ability to understand and use feedback theory and electronic control systems.

Expected results from this subject	Training and Learning Results
Knowledge of the techniques for feed-back amplifiers and oscillators.	C43 C44
Knowledge of the internal structures of the operational amplifiers and their structures.	C43 C44
Knowledge of the design of circuits based on operational amplifiers.	C43 C44
Knowledge of the design of power-supplies.	C42 C43 C44

Contents	
Topic	
Feedback amplifiers I	Feedback concept. Sample and mix networks. Feedback topologies. Feedback law.

Feedback amplifiers II	Negative and positive feedback. Parameters for the study of feedback. Benefits and draws of feedback. Effect on the uniform of gain. Effect on the harmonic distortion. Effect on the input and output impedances.
Feedback amplifiers III	Methods for the analysis: Simple or using matrix. Topology identifying. Amplifier without feedback, but with the load effect of the feedback network. The gain of the feedback amplifier. The input and the output impedances of the feedback amplifier.
Feedback amplifiers IV	Effect of the feedback on the frequency response. Bandwidth and stability. The effect of poles on the amplifier (one pole, two poles and three poles). Gain and phase margins. Nyquist criteria. Root places. Compensation methods.
Sine waveform oscillators	Barkhausen criteria. Design of a sinusoidal oscillator. RC oscillator. LC oscillator. Oscillator based on quartz crystals.
Operational amplifiers I	Internal structure of an operational amplifier. Current mirrors. Active loads. Voltage references. Technologies for the operational amplifiers: bipolars, bifet, cmos.
Operational amplifiers II	Analysis of the operational amplifier in the non inverting mode, using feedback. Voltage follower. Converters I-V and V-I. Integrator. Derivator. Applications.
Operational amplifiers III	Half-wave inverter rectifier . Full-wave inverter rectifier. Relaxation oscillator. Generator of triangle waves. Sinusoid oscillators based on the operational amplifier.
Power amplifiers	Output stages in class A, B and A-B. Full amplifier in class B. Full amplifier in class A-B. Introduction to the class-D amplifiers.
Regulated power supplies	Linear regulated power supplies. Protection to over current. Low drop-out (LDO).
Lab work 1	The effect of the feedback on a two-stage amplifier .
Lab work 2	Linear applications. Voltage-to-current converter. Integrator.
Lab work 3	Half-wave inverter rectifier. Full-wave inverter rectifier. Peack detector. Slope detector.
Lab work 4	Operational-based relaxation oscillator. Operational-based sinusoidal oscillator.
Lab work 5	Power amplifiers. Class B. Class A-B.
Lab work 6	Design of an active load. Design of a voltaje regulated supply.

Planning

	Class hours	Hours outside the classroom	Total hours
Mentored work	7	20	27

Laboratory practical	12	38	50
Lecturing	15	27.5	42.5
Problem solving	4	22.5	26.5
Objective questions exam	1	0	1
Problem and/or exercise solving	2	0	2
Laboratory practice	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
Mentored work	***The lecturer will lead the students in order to design an amplifier. For simulation: software to be used: ORCAD CIS Lite. *** This activity is collective. The students work in teams of two persons. Competencies C42, C43 and C44 (CE42, CE43 and CE44) will be addressed in these sessions.
Laboratory practical	***Simulations and real assembled circuits will be tested. For simulation: software to be used: ORCAD CIS Lite. *** This activity is collective. The students work in teams of two persons in each laboratory position. Competencies C42, C43 and C44 (CE42, CE43 and CE44) will be addressed in these sessions.
Lecturing	The lecturer will show some theoretical contents related to the subject. This activity is individual. Competencies C42, C43 and C44 (CE42, CE43 and CE44) will be addressed in these sessions.
Problem solving	The lecturer will solve some exercises related to the subject. This activity is individual. Competencies C42, C43 and C44 (CE42, CE43 and CE44) will be addressed in these sessions.

Personalized assistance

Methodologies	Description
Problem solving	The teacher will resolve the doubts of the students at the schedule established and published on the school website. (https://moovi.uvigo.gal/user/profile.php?id=11318).
Mentored work	The teacher will resolve the doubts of the students at the schedule established and published on the school website. (https://moovi.uvigo.gal/user/profile.php?id=11317).
Laboratory practical	The teacher will resolve the doubts of the students at the schedule established and published on the school website. (https://moovi.uvigo.gal/user/profile.php?id=11318).
Lecturing	The teacher will resolve the doubts of the students at the schedule established and published on the school website. (https://moovi.uvigo.gal/user/profile.php?id=11318).

Assessment

	Description	Qualification	Training and Learning Results
Mentored work	The students have to write a document about the assigned work. A single document for the group of two persons that work together in this job. The grade for both students in this job is the same. Competencies CE42, CE43 and CE44 will be assessed in these works.	10	C42 C43 C44
Objective questions exam	Multiple choice test. Competencies CE42, CE43 and CE44 will be assessed in these tests.	30	C42 C43 C44
Problem and/or exercise solving	Exercise test. Competencies CE42, CE43 and CE44 will be assessed in this test.	30	C42 C43 C44
Laboratory practice	Laboratory-work exam based on simulations and real circuits. Competencies CE42, CE43 and CE44 will be assessed in this test.	30	C42 C43 C44

Other comments on the Evaluation

CONTINUOUS ASSESSMENT OPTION:

The subject is evaluated in a continue way, by means of two partial exams. These exams cover the theoretical aspects. In addition, there is an exam for the lab-work and a tutored work.

This first partial exam includes themes from one to five. The second partial exam includes themes from six to ten. The weight of both partials is 60% from the total mark.

The two partials take place in the classroom, within the class time. These partials are approximately 90 minutes long. The first 30 minutes will be dedicated to a multiple-choice test. The other 60 minutes will be dedicated to exercises.

Inside each partial exam, the 60 minutes exam and the 30 minutes exam have the same weight.

In order to pass a partial exam (the first or the second), the student is required to obtain at least a mark of 5 over 10.

The student that passes only one partial will only have to try the other one at the final exam, which is the same for the students who do that exam as a recovery exam for the continuous assessment and for the students who do that exam as their global assessment.

The lab-work is evaluated using a unique exam, in the laboratory. The weight is 30%.

The weight of the tutored work in the continuous assessment is 10% of the total mark.

When a student attends the first partial, he or she accepts to follow the continuous assessment. Students that do not attend to the first partial will be assessed by means of a unique assessment, *** except in the case of the student's waiver of continuous assessment, a step for which in this matter the term is not restricted beyond what is established by the general regulations: regarding this matter, the waiver of continuous assessment is accepted at any moment.***

The mark that a student obtains in the lab-work is maintained until the extraordinary exam, except if the student does not want. In this case, the student will have to do partials and lab exams in the extraordinary exam.

In order to pass the subject, once partial exams have been passed, the student has to obtain a global mark (GM) of at least 5 points out of ten. The global mark is calculated acording to the following expression if the student has more than 5 points in each partial exam:

GM = 0.6 * TM + 0.3*LM + 0.1*RM

where

TM (Theory Mark) = Mean value of the partial marks; LM = lab mark; RM = report mark

If the mark of the student in any of the two partial theory exams is less than 5, then the value of GM is the minimum between 4.5 and 0.6*TM+0.3*LM+0.1*RM.

The lab exam will take place in the lab, the day of the last lab session.

GLOBAL ASSESSMENT OPTION:

The students that do not follow the continuous assessment will be assessed by means of a global assessment. The global assessment will consist of an exam with three parts: the first part covers the themes 1 to 5, the second part covers the themes 6 to 10 and the third part is a lab-work in the laboratory.

In order to pass the subject, the student has to obtain a mark of at least 5 points over ten for the first and second parts. In this case, the global mark (GM) is calculated according to the following formula:

GM = 0.6 * TM + 0.4*LM

where:

TM = Average mark of the first and second part of the exam; LM = lab mark

If the student does not obtain a mark of at least 5 in the first part or in the second part, the global mark would be the minimum between 4 and 0.6*TM + 0.4*LM.

IMPORTANT. MANDATORY ENROLLMENT.

If a student did not enter the continuous assessment mode but is interested in participate in the global assessmente, he or she must enroll in this assessment by talking to the professors at least two weeks before the day of the exam. Contact can be by e-mail. This helps in the organization of the lab work exam.

EXTRAORDINARY EXAM AND END OD FROGRAM EXAM

The extraordinary exam and the end of program exam have the same exam structure and the same rules (calculation of the mark and mandatory enrollment) as for the global assessment.

Sources of information
Basic Bibliography
Hambley, Allan R., **Electrónica**, 2ª ed., Pearson-Prentice Hall, 2001
Quintáns Graña, C., **Simulación de circuitos electrónicos con OrCAD® PSpice®**, 2.ª edición, Marcombo, 2021
Sergio Franco, **Design with operational amplifiers and analog integrated circuits**, third edition, McGraw-Hill,
Complementary Bibliography
Paul Horowitz y Winfield Hill, **The Art of Electronics**, Cambridge Univ. Press,
Horenstein, Mark N., **Microelectrónica**, 2ª ed., Prentice Hall, 1997
Malik, Norbert, **Circuitos electrónicos**, Prentice Hall, 1996
Rashid, Muhammad, **Circuitos microelectrónicos**, Thomson, 2002
Sedra, Adel, **Circuitos microelectrónicos**, 5ª ed., McGraw-Hill, 2006

Recommendations