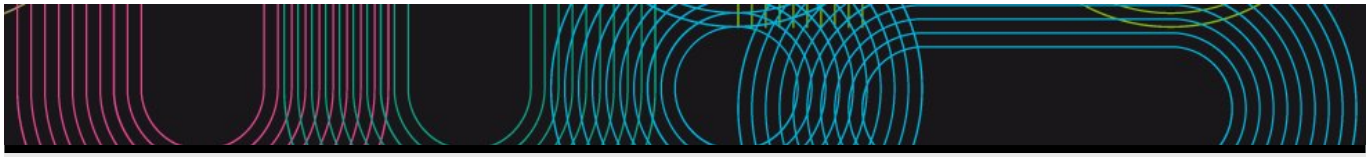

IDENTIFYING DATA				
Electronic Instrumentation and Sensors				
Subject	Electronic Instrumentation and Sensors			
Code	V05G301V01316			
Study programme	Grado en Ingeniería de Tecnologías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	3rd	2nd
Teaching language	Spanish Galician			
Department				
Coordinator	Costas Pérez, Lucía			
Lecturers	Costas Pérez, Lucía Pastoriza Santos, Vicente			
E-mail	lcostas@uvigo.es			
Web	http://moovi.uvigo.gal			
General description	The main purpose of the subject is to provide the theoretical and practical skills for the design and characterization of electronic instrumentation systems, and the range of sensors which provide analogical and digital signal in the input stage of said instrumentation systems. Course outline: + Analysis of sensor parameters. + Basic concepts about the physical principles of the sensors. + The most important application of sensors in electronic instrumentation. + Electronic instrumentation architectures, from the simplest point to point systems to the most complex distributed systems. International standards for electronic instrumentation are presented. + Design of programmable instrumentation: GPIB, VXI and PXI buses. + Classification of architectures for electronic instrumentation. Introduction of wired and wireless field buses. The documentation of the course will be in Spanish. It will be taught in Galician and Spanish. It will be assessed in Spanish.			

Training and Learning Results	
Code	
B3	CG3: The knowledge of basic subjects and technologies that enables the student to learn new methods and technologies, as well as to give him great versatility to confront and adapt to new situations
B4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
B5	CG5: The knowledge to perform measurements, calculations, assessments, appraisals, technical evaluations, studies, reports, task scheduling and similar work to each specific telecommunication area.
C42	(CE42/SE4): The ability to apply electronics as support technology in other fields and activities and not only in information and communication technologies.
C46	(CE46/SE8): The ability to specify and use electronic instrumentation and measurement systems.
D2	CT2 Understanding Engineering within a framework of sustainable development.
D3	CT3 Awareness of the need for long-life training and continuous quality improvement, showing a flexible, open and ethical attitude toward different opinions and situations, particularly on non-discrimination based on sex, race or religion, as well as respect for fundamental rights, accessibility, etc.

Expected results from this subject	Training and Learning Results		
Knowledge of the distinct types of sensors and his applications.	B3	C42 C46	D2 D3

Capacity for the development of electronic circuits of conditioning of signal.	B4 B5	C42 C46	D2 D3
Knowledge and utilisation of computer tools for treatment of data and representation of the information.	B4 B5	C42 C46	
Knowledge of the basic principles of the programmable instrumentation and his utilisation.	B3	C42 C46	D2 D3

Contents	
Topic	
Unit 1: Introduction to sensors.	Energy conversions. Concepts of sensor, transducer and actuator. Dynamic and static features. Other features. Selection of sensors.
Unit 2: Temperature resistive sensors. Strain gauges.	Temperature resistive sensors: General features. Types. Conditioning . Application examples. Strain gauges: Basic principles. General features. Types of using. Conditioning . Application examples.
Unit 3: Photoresistive and Optoelectronic. Other resistive sensors.	Photoresistive and Optoelectronic: Basic principles. General features. Encoders. Conditioning. Application examples. Other resistive sensors: Gas sensors. Magnetoresistors. Potentiometers. Basic principles. General features. Conditioning . Application examples.
Unit 4: Capacitive sensors. Inductive and magnetic sensors.	Capacitive sensors: Introduction. Measurements principles. Features. Conditioning. Proximity sensors. Application examples. Inductive and magnetic sensors: Introduction. Basic principles. Variable transformer types. Features. Conditioning. Hall effect sensors. Application examples.
Unit 5: Thermocouples. Other sensors.	Thermocouples: Basic principles. General features. Calibration scales. Conditioning. Application examples. Other sensors: Pyroelectric. Ultrasounds. Magnetostrictive.
Unit 6: Programmable instrumentation. Standards on programmable instrumentation	Programmable instrumentation. Standards on programmable instrumentation. General features.
Practice 1: Introduction to the LabVIEW Application Development Environment	Introduction to LabVIEW environment by means of basic examples of programming.
Practice 2: Temperature sensors. NTC thermistor.	Signal conditioning and virtual instrument development for measurement
Practice 3: Optoelectronic sensors. PIN photodiode.	Spectral response analysis.
Practice 4: Capacitive sensors. Accelerometer.	Signal analysis and post-processing, and virtual instrument developing for tilt measurement.
Practice 5: Programmable Instrumentation I.	Frequency response test of two RC circuits via the programmable control of the laboratory instrumentation. The programmable control will realise through a USB connection from the PC to each instrument.
Practice 6: Programmable Instrumentation II.	To develop an application that verify the frequency response of a RC circuit by means of the programmable control of some of the instruments situated in a VXI chassis. The programmable control of each instrument from the PC will realise through a LAN connection and using a GPIB - Ethernet gateway .
Groups C: Work of documentation on thematic of interest that are not included in the contents of the theoretical parts-practical of the matter.	(*)

Planning			
	Class hours	Hours outside the classroom	Total hours
Introductory activities	2	1	3
Lecturing	16	26	42
Laboratory practical	14	28	42
Mentored work	7	29	36
Objective questions exam	3	24	27

*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	Subject presentation. Presentation of laboratory sessions, instrumentation and software resources to be used. Individual task. In these sessions, the skills B3, B4, B5, C42, C46, D2 and D3 (DCG3, CG4, CG5, CE42, CE46, CT2 and CT3) will be worked.
Lecturing	The lecturer will explain in the classroom the main contents of the subject. The students, individually, have to manage the proposed bibliography to carry out a self-study process in a way that leads to acquire the knowledge and the skills related to the subject. The lecturer will answer the students questions in the classroom or at the office. In these sessions, the skills B3, B4, B5, C42, C46, D2 and D3 (DCG3, CG4, CG5, CE42, CE46, CT2 and CT3) will be worked.
Laboratory practical	Small-group activities designed to apply the main concepts and definitions of the subject. The student will be asked to acquire the basic skills to manage the laboratory instrumentation, software tools and components in order to construct and test electronic circuits. The student has to develop and demonstrate autonomous learning and collaborative skills. He/she is supposed to be able to manage bibliography and recently acquired knowledge. Possible questions can be answered in the laboratory sessions or at the lecturers office. Software to be used: National Instruments (NI) LabVIEW and NI Multisim. In these practises, the skills B3, B4, B5, C42, C46, D2 and D3 (DCG3, CG4, CG5, CE42, CE46, CT2 and CT3) will be worked.
Mentored work	The students have to manage basic concepts to search and select information in order to get a deeper understanding in some specific fields related to the subject. This is a group activity. The lecturer will propose in the classroom the topic of this group task and monitor the students work in personalized attention sessions. In these sessions, the skills B3, B4, B5, C42, C46, D2 and D3 (DCG3, CG4, CG5, CE42, CE46, CT2 and CT3) will be worked.

Personalized assistance	
Methodologies	**Description**
Lecturing	The/ace students will have occasion to attend to tutoring sessions personalised or in groups. The information can find published in the web page: https://moovi.uvigo.gal/user/profile.php?id=11301. In said tutoring sessions will attend doubts and queries and will orient on how tackle their study.
Laboratory practical	The/ace students will have occasion to attend to tutoring sessions personalised or in groups. The information can find published in the web page: https://moovi.uvigo.gal/user/profile.php?id=11330. In said tutoring sessions will attend doubts and queries on the development of the practices of laboratory, the handle of the instrumentation, the setting of circuits and the tools of programming.
Mentored work	The/ace students will have occasion to attend to tutoring sessions personalised or in groups. The information can find published in the web page: https://moovi.uvigo.gal/user/profile.php?id=11301. Teachers will attend doubts and queries on the work mentored work proposed.

Assessment			
	Description	Qualification	Training and Learning Results
Laboratory practical	The lecturers will check the level of compliance of the students with the goals related to the laboratory skills. They will consider the work of the students carried out before the practical session to prepare the proposed tasks, the attendance, and the quality of the work done. Marks for each session (LSM: Laboratory Session Mark) will be assigned in a 10 points scale. Final mark of laboratory, FML, will be assessed in a 10 points scale. For the evaluation of these sessions, the lecturer will assess the group work (the same mark for each member), the individual preliminary tasks and the answers to personalised questions for each session. In these works, the skills B3, B4, B5, C42, C46, D2 and D3 (DCG3, CG4, CG5, CE42, CE46, CT2 and CT3) will be evaluated.	35	B3 C42 D2 B4 C46 D3 B5
Mentored work	The lecturers will consider the quality of results obtained, their presentation and analysis, and the quality of the final report. The tutored work mark, TWM, will be graded in a 10 points scale. For the evaluation of the project, the lecturer will assess the group work (the same mark for each member). In these works, the skills B3, B4, B5, C42, C46, D2 and D3 (DCG3, CG4, CG5, CE42, CE46, CT2 and CT3) will be evaluated.	15	B3 C42 D2 B4 C46 D3 B5
Objective questions exam	The lecturers will check the level of compliance of the students with the goals related to the theory skills. Marks for each test will be assessed in a 10 points scale. Final mark of theory, FMT, will be assessed in a 10 points scale. In these tests, the skills B3, B4, B5, C42, C46, D2 and D3 (DCG3, CG4, CG5, CE42, CE46, CT2 and CT3) will be evaluated.	50	B3 C42 D2 B4 C46 D3 B5

Other comments on the Evaluation

1. Continuous Assesment

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 understands that the students that assist to the two first activities evaluated just after a month from the beginning of the classes **opts by the Continuous Assesment** of the subject.

The subject comprises three different parts: theory (50 %), laboratory practical (35%) and tutored work (15%). The marksare valid only for the current academic course. The final grade for the students which have selected this option, may not be "no standing".

Any one of the activities following this evaluation type is not recoverable, except that they are properly justified following the criteria billed in the rule approved by the Claustro of the University on 18 April 2023.

1.a Theory

Two partial testing (PT) are scheduled. The first exam will be performed after unit 5, in the usual weekly scheduling of the theoretical classes. The second exam will be performed during the examination period in the date specified in the academic calendar.

Each theory exam will be comprised short answer tests and long answer development. Marks for each theory exam will be assessed in a 10 points scale.

The final mark of theory (FMT), will be the arithmetic mean of the two parts:

FMT = (PT1 + PT2)/2

The minimum mark required to pass the theory is of 5 for each test (PTi>=5).

1.b Laboratory

Seven laboratory sessions are scheduled. Each session lasts approximately 120 minutes and the students will work in small groups. This part also will be assessed by continuous assessment. Marks for each laboratory session (LSM) will be assessed in a 10 points scale.

The final mark of laboratory (FML) is calculated as the arithmetic mean of the individual laboratory session marks.

In order to pass the laboratory part the students can not miss more than one practical sessions and the minimum mark required is of 5 (FML>=5).

1.c Tutored work

In the first session of C hours, lecturers will present the objectives and the schedule of the work. They also assign a specific work to each group. After that, the most important part of the workload will be developed outside the classroom hours. The lecturers will monitor the group work and the individual student work in the following sessions of C hours. The students will be duly informed by the lecturer about the deadline for the report submission.

The minimum mark required to pass this part is of 5, TWM (Tutored Work Mark) >=5, and the students are only allowed to miss one tutored work session.

2. Global Assesment

The students who prefer a different educational policy can attend an exam on a scheduled date. This exam will comprise three parts (similar to the activities completed by the continuously assessed students): theory exam, practical exam and tutored work. Dates will be specified in the academic calendar. In order to attend the practical exam and to assign the tutored work, the students have to contact to the lecturer according to an established procedure. The procedure will be published in advance.

The theory exam will be comprised two exams (PT) each one with short answer tests and long answer development. Marks for each test will be assessed in a 10 points scale. The final mark of theory (FMT) is calculated as the arithmetic mean of the individual marks:

FMT = (PT1 + PT2)/2

The practical exam will include the implementation of electronic circuits developed in the laboratory sessions as well as

some short answer questions related to these sessions. The practical exam will be assessed in a 10 points scale and this mark will be the final mark of aboratory (FML).

The student will also do a tutored work and prepare a written report to be handed in just before the exam.

3. Final mark of the subject
In order to pass the subject, students will be required to pass the three parts:

theory: FMT>=5 with PT1>=5 and PT2>=5

and laboratory: FML>=5

and tutored work: TWM>=5

In this case the final mark (FM) will be:

FM = 0.5·FMT + 0.3·FML + 0.15·TWM

However, when the students do not pass all parts, the final mark will be:

FM = min({ 4.9; 0.5·FMT + 0.3·FML + 0.15·TWM })

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

4. Extraordinary opportunity and End-of-program exam

The assessment policy in these calls will follow the scheme described in the single assessment: a theory exam, a practical exam and a tutored work. Dates will be specified in the academic calendar. In order to attend the practical exam and to assign the tutored work, the students have to contact to the lecturer according to an established procedure. The procedure will be published in advance.

The marks obtained during the current academic year in the first opportunity are kept in the second one for those parts in

which the student has not attended. Moreover, in the second opportunity, the students can not take an exam or a tutored work task if they have got a pass previously in the first opportunity.

The final mark will be calculated as it has described in section 3.

Sources of information

Basic Bibliography

Black, J. (editor), **The system engineering handbook: a guide to building VME bus and VXI bus Systems**, Academic Press, 1992

Mariño, P., **Las comunicaciones en la empresa: normas, redes y servicios**, 2ª ed., RAMA, 2002

Norton, H., **Sensores y analizadores**, Gustavo Gili D.L., 1984

Pérez García, M.A., **Instrumentación Electrónica**, 1ª ed., Ediciones Paraninfo, S.A., 2014

Pérez García, M.A., Álvarez Antón, J.C., Campo Rodríguez, J.C., Ferrero Martín, F.J., y Grillo Orteg, **Instrumentación Electrónica**, 2ª ed., Thomson, 2004

Complementary Bibliography

del Río Fernández, J., Shariat-Panahi, S., Sarriá Gandul, S., y Lázaro, A.M., **LabVIEW: Programación para Sistemas de Instrumentación**, 1ª ed., Editorial Garceta, 2011

Recommendations

Subjects that are recommended to be taken simultaneously

Programmable Electronic Circuits/V05G301V01302
Analogue Electronics/V05G301V01311
Data Acquisition Systems/V05G301V01314