



IDENTIFYING DATA

Electronic instrumentation

Subject	Electronic instrumentation			
Code	V12G360V01701			
Study programme	Grado en Ingeniería en Tecnologías Industriales			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	4th	1st
Teaching language	Spanish			
Department				
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General description	<p>A Instrumentación Electrónica é a parte da electrónica que se ocupa da medición de calquera tipo de magnitude física, da conversión da mesma a magnitudes eléctricas e do seu tratamento para proporcionar a información adecuada a un sistema de control, a un operador humano ou ambos. A instrumentación ten dous grandes temas de traballo:</p> <ul style="list-style-type: none"> - O estudo dos sensores e dos seus circuítos de acondicionamento. - O estudo dos equipos de Instrumentación, que se empregan na industria para a medida de calquera tipo de variable física. 			

Training and Learning Results

Code	
B3	CG3 Knowledge in basic and technological subjects that will enable them to learn new methods and theories, and equip them with versatility to adapt to new situations.
C23	CE23 Applied knowledge of electronic instrumentation
D2	CT2 Problems resolution.
D9	CT9 Apply knowledge.
D17	CT17 Working as a team.

Expected results from this subject

Expected results from this subject	Training and Learning Results		
(*)	B3	C23	
(*)		C23	D9
New			D2 D9
New		C23	D2
New			D17

Contents

Topic	
Topic 1: Introduction to the electronic instrumentation	The electronic instrumentation in the context of the control of processes. Systems of measure and his characterisation.
Topic 2: Systems of Acquisition of Data (DAS or DAQ). Auxiliary circuits	Bridges of measure. Fixers of tension. Sources of current. Converters V/I and I/V.
Topic 3: DAS. Amplification and signals filtering	Amplifiers of instrumentation, programmable amplifiers, amplifier of isolation. Types of filters. Technicians of implementation of active filters.
Topic 4: DAS. Circuits of conversion and multiplexed	Circuits of show and retention (S&H). Conversion A/D and D/A, types and technical characteristics. Analog switches. Multiplexer analog.

Topic 5: Implementation of systems of acquisition of data	Basic structures. Criteria of election in function of the parameters of the system.
Topic 6: Physical principles of sensors	Introduction. Piezoelectricity. Magnetostriction. Piezoresistivity. Pyroelectricity. Magnetoresistance. Thermoelectricity. Thermoresistivity. Photoresistivity. Inductive sensors. Capacitive sensors. Ultrasonic sensors.
Topic 7: general Characteristics of the sensors	Technical characteristics. Types of commercial exits. Connection of sensors to electronic systems of control.
Topic 8: Proximity sensors	Inductive, capacitive, ultrasonic, optoelectronic, magnetic and safety sensors.
Topic 9: Sensors of temperature and of discharge	Sensors of Temperature: Thermocouples, sensors of infrared and integrated sensors. Sensors of discharge: Sensors of differential pressure, vortex, acceleration of *Coriolis, of turbine, electromagnetic. Criteria of selection.
Topic 10: Pressure and level sensors	Pressure sensors (Primary measuring elements: Bourdon tube, diaphragm, bellows), potentiometric, piezoelectric, capacitive, inductive, strain gauge and magnetostrictive. Level sensors: Ultrasonic, resistive, float, static pressure, differential pressure, conductivity, capacitive, inductive, optical, rotary vane and radioactive. Selection criteria.
Topic 11: Displacement sensors	Inductive sensors: LVDT, RVDT, Synchrogenerator and Resolver. Optoelectronic sensors: Absolute and incremental encoders. Applications. Selection criteria.
Topic 12: Sensors of electrical and magnetic variables	Transformer of intensity. *Shunt. Sensors of effect *Hall. Measure of magnetic fields with *Magnetorresistencias. Criteria of selection.
Topic 13: Introduction to the control of processes based in the use of microcontrollers	Introduction to the control of processes Introduction to the microcontrollers Introduction to the actuators: hydraulic, tyres and electronic (Electronics of Power)
Topic 14: Teams of electronic instrumentation	Classification, technical characteristics and connection of teams of instrumentation. Criteria of selection. Buses of instrumentation.
Topic 15: Introduction to Power Electronics (PE)	Introduction. Structure of the systems of PE. Types of converters. Semiconductors of powers. Passive components in PE. Calculation of powers.
Practice 1. Introduction to the Virtual instrumentation. LabVIEW.	The execution data flow on LabVIEW. Frontal panel and diagrams of blocks. Description of the main types of data and structures of programming.
Practice 2: Introduction to the control of processes based in the System On Chip (SOC) ESP32.	Introduction to the control of processes based in uControladores. Study of the ESP32. Introduction to the surroundings of development of the platform M5Stack. Implementation of an application of control based in the M5Stack Stick C
Practice 3: System of acquisition of data for the measure of temperature. Mentored work.	It will be implementing a system of acquisition of complete data for the conditioning of a sensor of temperature PT1000. - Implementation of a circuit of the measure and the control of a physical variable and his back acquisition by means of distinct hardware of capture. - Incorporate the information captures in a system of management of the information, to make tasks of control of production and control of processes.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	28	30	58
Laboratory practical	12	6	18
Problem solving	8	13	21
Mentored work	6	30	36
Essay questions exam	3	10	13
Objective questions exam	1	3	4

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

Methodologies

	Description
Lecturing	They will develop in the schedules fixed by the direction of the centre. They consist in an exhibition, by part of the professor, of the contents of the matter. Also it will proceed to show examples and technical solutions that illustrate properly the problematic to treat. The student will be able to expose all the doubts and questions that consider timely, during the session. The teacher will look for the most active possible of the student.

Laboratory practical	It will show to the student some practical settings or simulations on the matter treated that they put of self-evident the technical characteristics of the settings made, as well as the form to make measures in the same by means of sensors and the instrumentation of the laboratory.
Problem solving	The complementary activity of the magistrate's sessions in which they formulate problems and/or exercises related to the subject. The student will have to develop suitable solutions to the problems and/or exercises proposed in the classroom and of other extracted of the bibliography. They will identify possible doubts that will resolve in the classroom or in personalized tutorials.
Mentored work	This time devotes to the realisation of works of laboratory in team, related with the conditioning of sensors, visualisation of the variable measured and storage of information.

Personalized assistance

Methodologies	Description
Laboratory practical	The teacher will personally attend to the doubts and queries of the students, about the study of theoretical concepts, laboratory practices or projects. Students will have the opportunity to attend personalized tutorials or in groups in the teacher's office at the time established for that purpose at the beginning of the course and which will be published on the subject page.
Mentored work	In the practical classes and in tutorials each of the doubts that arise in the completion of the work will be solved in a personalized way.

Assessment

	Description	Qualification	Training and Learning Results
Laboratory practical	The students will make the designs and planned settings in the billed of the practice and will deliver a memory with the results of the same.	10	D9 D17
Mentored work	Once made the supervised work, the students will owe to elaborate a descriptive memory. It will fix a day for the delivery of the memory and the presentation of the work made, to the professor. This note will form part of the continuous evaluation.	30	D9 D17
Essay questions exam	In the dates indicated by the calendar of examinations of the centre, will make the final proofs that will consist in problems of development.	30	D2
Objective questions exam	In the dates indicated by centre and by means of continuous evaluation, will make proofs of short questions of test.	30	B3 C23

Other comments on the Evaluation

Long answer tests and multiple choice tests will be carried out on the dates set by the center or by the teacher and will represent 60% of the final grade. The remaining 40% will correspond to the grade obtained throughout the course, through continuous evaluation, of the laboratory practices and the supervised work. In each of these evaluations a minimum grade of 30% will be required

Students who are recognized by the management of the center for their resignation from continuous assessment, must attend the final test. This will represent 60% of the grade, the remaining 40% will be obtained through a practical exam and the completion of a work. In this case, the practical exam and the work will be compulsory, and in these tests a minimum grade of 50% must be obtained.

In the second call, the same procedure will be followed.

The practice note will only be saved for one academic year.

Ethical commitment:

The student is expected to exhibit appropriate ethical behavior. In the case of detecting unethical behavior (copying, plagiarism, use of unauthorized electronic devices, and others) it will be considered that the student does not meet the necessary requirements to pass the subject. In this case, the overall grade in the current academic year will be a failure (0.0).

The use of any electronic device will not be allowed during the evaluation tests unless expressly authorized. The fact of introducing an unauthorized electronic device in the exam room will be considered a reason for not passing this subject in this academic year and the overall grade will be failed (0.0).

THE ACQUISITION OF SKILLS AND ITS INFLUENCE ON THE EVALUATION

In this subject there is no competency assessment approach. Next, it is specified how the different teaching activities exercise the student in the different competencies and how their acquisition conditions the final grade obtained by the

student.

CG3. Knowledge of basic and technological subjects, which enables them to learn new methods and theories and gives them the versatility to adapt to new situations.

The acquisition of this competence is guaranteed (in the scope of the subject) by its own contents. The self-assessment activities, the practicals and the different assessment tests deal with these content of a technological nature.

CT2. Problem resolution.

Students exercise in this competence through the proposed activities: problem sets and theoretical resolution of the assemblies proposed in the practice statements. The acquisition of competence in the field of the subject is justified by the fact that the assessment tests (thematic blocks and individual tests) consist almost entirely of problem solving.

This competence is achieved and evaluated in the proposed laboratory work. These are carried out in groups of two and at the end of them, each group must submit a written report of the activities carried out. The students who prepare the best works must make an oral presentation.

CT9. Apply knowledge.

The students exercise this competence, especially in the laboratory sessions, where they have to transfer to the simulations and to the assembly and real measurements what was studied in the theoretical sessions. The laboratory sessions are evaluated one by one, averaging the final grade as long as there is minimal attendance and use.

CT17 Teamwork.

The students exercise this competence in the laboratory sessions, since these sessions are carried out in teams of two. Collaboration between both students is necessary to successfully carry out the setups, measurements and data collection required in each experiment. The practice teacher verifies that the prior preparation and development of each of the sessions is the result of the collaboration of the two members of each group. In case of detecting anomalies in this sense, the qualifications of each member of the group are penalized and individualized.

Sources of information

Basic Bibliography

M. A. Pérez García, J. C. Álvarez Antón, J. C. Campo Rodríguez, F. J. Ferrero Martín y G. J. Grillo, **Instrumentación Electrónica**, Thomson, 2003

Franco, Sergio, **Diseño con amplificadores operacionales y circuitos integrados analógicos**, 3ª edición, Mc Graw-Hill, 2013

Del Río Fdez, J., **LabVIEW: Programación de sistema de instrumentación**, 1ª, Garceta, 2011

Pérez García, M., **Instrumentación Electrónica: 230 problemas resueltos.**, 1ª, Garceta, 2012

Complementary Bibliography

Enrique Mandado Pérez, Jorge Marcos Acevedo, Celso Fernández Silva y José I. Armesto Quiroga, **Autómatas programables y sistemas de automatización**, Marcombo, 2009

Faludi, Robert, **Building wireless sensor networks**, O' Reilly, 2011

Recommendations

Subjects that continue the syllabus

Control and industrial automation/V12G360V01801

Subjects that it is recommended to have taken before

Automation and control fundamentals/V12G360V01304

Basics of circuit analysis and electrical machines/V12G360V01302

Electronic technology/V12G360V01401