

340127 - INEL-K6O10 - Electronic Instrumentation

Coordinating unit:	340 - EPSEVG - Vilanova i la Geltrú School of Engineering
Teaching unit:	710 - EEL - Department of Electronic Engineering
Academic year:	2019
Degree:	BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory) BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional) BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
ECTS credits:	6
Teaching languages:	Catalan

Teaching staff

Coordinator:	Joaquín del Río Fernández
Others:	Joaquin del Rio Fernandez

Degree competences to which the subject contributes

Specific:

6. CE20. Fundamental knowledge and application of analogue electronics.
7. CE21. Knowledge of basics and application of digital electronics and microprocessors.
8. CE23. Applied knowledge of electrical instrumentation.
9. CE24. Ability to design electrical, analog, digital and power systems.
10. CE28. Applied knowledge of industrial and communication computing.

Transversal:

1. EFFECTIVE USE OF INFORMATION RESOURCES - Level 3. Planning and using the information necessary for an academic assignment (a final thesis, for example) based on a critical appraisal of the information resources used.
2. EFFECTIVE USE OF INFORMATION RESOURCES. Managing the acquisition, structure, analysis and display of information from the own field of specialization. Taking a critical stance with regard to the results obtained.
3. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 3. Communicating clearly and efficiently in oral and written presentations. Adapting to audiences and communication aims by using suitable strategies and means.
4. TEAMWORK - Level 2. Contributing to the consolidation of a team by planning targets and working efficiently to favor communication, task assignment and cohesion.
5. TEAMWORK. Being able to work as a team player, either as a member or as a leader. Contributing to projects pragmatically and responsibly, by reaching commitments in accordance to the resources that are available.

Teaching methodology

The fundamental concepts will be explained in lectures, and from students' personal and guided works, concepts and applications will be learned. The lectures dedicated to solve problems will involve the participation of students, allowing them to solve real practical problems. These actions will be complemented with laboratory sessions, software simulations and the evaluation of the results, all these in the context of an instrumentation project design, which includes a research stage and a team work collaboration.

Learning objectives of the subject

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The purpose of this course is to study and learn the most common techniques for electronic measurements of electrical and physical parameters of an industrial environment. From the study of the main transducers, signal conditioners and associated electronic circuits, instrumentation and data acquisition systems will be developed for the subsequent data processing of the information obtained from the different measurement environments. The foundations and structure of various equipment for general use and specific instrumentation, will be analyzed as well

Study load

Total learning time: 150h	Hours large group:	30h	20.00%
	Hours medium group:	0h	0.00%
	Hours small group:	30h	20.00%
	Guided activities:	0h	0.00%
	Self study:	90h	60.00%

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Content

<p>INSTRUMENTATION AND MEASUREMENT CHAIN OVERVIEW</p>	<p>Learning time: 8h</p> <p>Theory classes: 2h Practical classes: 1h Laboratory classes: 1h Guided activities: 0h Self study : 4h</p>
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<p>Description: Instrumentation concept. Electrical signal. Analog and digital measurement chain. The transmission of the measured signal. Telemetry. Measuring bridges.</p> <p>Specific objectives: General overview of instrumentation systems. Study of basic concepts.</p>	
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<p>INSTRUMENTATION AMPLIFIERS</p>	<p>Learning time: 33h</p> <p>Theory classes: 6h Practical classes: 3h Laboratory classes: 3h Guided activities: 1h Self study : 20h</p>
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<p>Description: The need for amplification of the measured signal. Ideal and real operational amplifiers. Differential and instrumentation amplifiers. The isolation amplifier</p> <p>Related activities: Laboratory Practice Laboratory Written Test Delivery of solved problems collection</p> <p>Specific objectives: Get in touch with concepts related to signal conditioning, such as common mode and differential voltages. CMRR. Load effect.</p>	
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<p>TRANSDUCERS AND MEASUREMENT CONVERTERS</p>	<p>Learning time: 38h Theory classes: 8h Practical classes: 4h Laboratory classes: 4h Guided activities: 2h Self study : 20h</p>
<p>Description: Type transducers: active and passive. Transducers general characteristics. Measurement of strain. Strain gauges. The Wheatstone bridge. Three-wire assembly. Temperature measurements. RTD. NTC and PTC thermistors. Semiconductor union sensors. Thermocouples. Displacement sensors. Capacitive sensors. Inductive Sensors. Differential Transformer</p> <p>Related activities: Delivery of solved problems collection Written theory test -problems</p> <p>Specific objectives: Analyze and design measurement systems for reference industrial parameters.</p>	
<p>ANALOG FUNCTIONS AND MEASURED SIGNALS</p>	<p>Learning time: 28h Theory classes: 6h Practical classes: 3h Laboratory classes: 3h Guided activities: 1h Self study : 15h</p>
<p>Description:</p> <p>Logarithmic and antilog converters. Analog multipliers. Integrated multifunction modules. Applications</p> <p>Specific objectives: Study of different systems for linearization and analog signal processing</p>	

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<p>THE ELECTRONIC ASSOCIATED TO THE DIGITAL MEASUREMENT CHAIN</p>	<p>Learning time: 24h Theory classes: 4h Practical classes: 2h Laboratory classes: 2h Guided activities: 1h Self study : 15h</p>
<p>Description: Components of the digital measurement chain. The architecture of data acquisition systems. Digital/Analog and Analog/Digital converters. Sample and Hold circuits. Voltage/Frequency Converters</p> <p>Related activities: Delivery of solved problems collection Practical work in groups</p> <p>Specific objectives: Study of the Analog/Digital interface.</p>	
<p>ANALYSIS AND DESIGN OF INSTRUMENTATION. INSTRUMENTATION</p>	<p>Learning time: 19h Theory classes: 4h Practical classes: 2h Laboratory classes: 2h Guided activities: 1h Self study : 10h</p>
<p>Description: Design phases of a measurement equipment. Design tools. Industrial communication systems. Transmission Lines. Communication within the same equipment (I2C, SPI, etc). Communication between equipments (GPIB, current loop, RS232, Ethernet, USB, etc). Wireless systems.</p> <p>Related activities: Laboratory Practice Laboratory Written Test Written theory test -problems</p> <p>Specific objectives: To have a general overview of the measurement systems, and the phases of industrial design of electronic equipment</p>	

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Qualification system

60% theory grade (exams)

40% grade of the laboratory exam.

Theory note = 30% 1st partial + 30% 2nd partial

Laboratory note = grade of the exam at the laboratory. It will be necessary to deliver laboratory reports to be able to do the laboratory exam.

It is a necessary condition to pass the subject to carry out the practices in the laboratory, present the associated reports and take the laboratory exam.

Bibliography

Basic:

Pérez García, Miguel Ángel [et al.]. Instrumentación electrónica. 2a ed. Madrid: Thomson, 2004. ISBN 8497321669.

Río Fernández, Joaquín del [et al.]. LabVIEW : programación para sistemas de instrumentación. Madrid: Ibergarceta Publicaciones, 2011. ISBN 9788492812684.

Pallás Areny, Ramón. Sensores y acondicionadores de señal. 4a ed. Barcelona [etc.]: Marcombo Boixareu, 2003. ISBN 8426713440.

Complementary:

Creus Solé, Antonio. Instrumentación industrial. 8a ed. Barcelona: Marcombo, 2011. ISBN 9788426716682.

Manuel Lázaro, Antonio [et al.]. Problemas resueltos de instrumentación y medidas electrónicas. Madrid: Paraninfo, 1994. ISBN 8428321418.

Others resources:

Exams repository:

<https://examens.upc.edu/curs/340127/683>