Course guide
340127 - INEL-K6O10 - Electronic Instrumentation

Last modified: 18/06/2024

Unit in charge: Vilanova i la Geltrú School of Engineering
Teaching unit: 710 - EEL - Department of Electronic Engineering.

Degree: BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Optional subject).

Academic year: 2024 **ECTS Credits:** 6.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: 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 electronical instrumentation.
9. CE24. Ability to design electronical, analog, digital and power systems.
10. CE28. Applied knowledge of industrial and communication computing.

Transversal:
1. EFFECTIVE USE OF INFORMATI0N 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

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

Type	Hours	Percentage
Hours large group	30,0	20.00
Self study	90,0	60.00
Hours small group	30,0	20.00

Total learning time: 150 h

CONTENTS

INSTRUMENTATION AND MEASUREMENT CHAIN OVERVIEW

Description:
Instrumentation concept. Electrical signal. Analog and digital measurement chain. The transmission of the measured signal. Telemetry.
Measuring bridges.

Specific objectives:
General overview of instrumentation systems. Study of basic concepts.

Full-or-part-time: 8h
Theory classes: 2h
Practical classes: 1h
Laboratory classes: 1h
Self study : 4h

INSTRUMENTATION AMPLIFIERS

Description:
The need for amplification of the measured signal. Ideal and real operational amplifiers. Differential and instrumentation amplifiers.
The isolation amplifier

Specific objectives:
Get in touch with concepts related to signal conditioning, such as common mode and differential voltages. CMRR. Load effect.

Related activities:
Laboratory Practice
Laboratory Written Test
Delivery of solved problems collection

Full-or-part-time: 33h
Theory classes: 6h
Practical classes: 3h
Laboratory classes: 3h
Guided activities: 1h
Self study : 20h

TRANSDUCERS AND MEASUREMENT CONVERTERS

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

Specific objectives:
Analyze and design measurement systems for reference industrial parameters.

Related activities:
Delivery of solved problems collection
Written theory test -problems

Full-or-part-time: 38h
Theory classes: 8h
Practical classes: 4h
Laboratory classes: 4h
Guided activities: 2h
Self study : 20h

ANALOG FUNCTIONS AND MEASURED SIGNALS

Description:

Logarithmic and antilog converters. Analog multipliers. Integrated multifunction modules. Applications

Specific objectives:
Study of different systems for linearization and analog signal processing

Full-or-part-time: 28h
Theory classes: 6h
Practical classes: 3h
Laboratory classes: 3h
Guided activities: 1h
Self study : 15h

THE ELECTRONIC ASSOCIATED TO THE DIGITAL MEASUREMENT CHAIN

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

Specific objectives:

Study of the Analog/Digital interface.

Related activities:
Delivery of solved problems collection
Practical work in groups

Full-or-part-time: 24h
Theory classes: 4h
Practical classes: 2h
Laboratory classes: 2h
Guided activities: 1h
Self study : 15h

ANALYSIS AND DESIGN OF INSTRUMENTATION. INSTRUMENTATION

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.

Specific objectives:

To have a general overview of the measurement systems, and the phases of industrial design of electronic equipment

Related activities:
Laboratory Practice
Laboratory Written Test
Written theory test -problems

Full-or-part-time: 19h
Theory classes: 4h
Practical classes: 2h
Laboratory classes: 2h
Guided activities: 1h
Self study : 10h

GRADING SYSTEM

60% theory grade (exams)
35% laboratory grade
5% exercises and class participation grade.

Theory grade = 30% first midterm + 30% second midterm
Laboratory grade = based on the laboratory exam and the practice reports. To take the exam, it is necessary to have submitted the practice reports.
It is a necessary condition to pass the course to perform the laboratory practices, submit the associated reports, and take the laboratory exam.

The reassessment of the course can be taken by all students who have a total grade between 2 and 4.9, and the final grade will be a maximum of 5 for the students who need to take it. The reassessment will cover the part corresponding to the theory exams.

BIBLIOGRAPHY

Basic:
- Pérez García, Miguel Ángel. Instrumentación electrónica. Madrid: Paraninfo, 2014. ISBN 9788428337021.
- 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 [on line]. 8a ed. Barcelona: Marcombo, 2011 [Consultation: 20/02/2024]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=9767. ISBN 9788426716682.
- Manuel Lázaro, Antonio [et al.]. Problemas resueltos de instrumentación y medidas electrónicas. Madrid: Paraninfo, 1994. ISBN 8428321418.

RESOURCES

Other resources:
Exams repository:
https://examens.upc.edu/curs/340127/683