Course guide
330108 - IE - Electronic Instrumentation

Last modified: 25/04/2024

Unit in charge: Manresa School of Engineering
Teaching unit: 750 - EMIT - Department of Mining, Industrial and ICT Engineering.

Degree: BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2016). (Compulsory subject).
BACHELOR'S DEGREE IN AUTOMOTIVE ENGINEERING (Syllabus 2017). (Optional subject).

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

LECTURER

Coordinating lecturer: Martinez Teixidor, Inmaculada

Others: Delis Ramos, Francisco Manuel

REQUIREMENTS

Have approved or taken Analog Electronics (330104).

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. Applied knowledge of electronic instrumentation.
2. Knowledge of modeling and simulation of measurement systems.

Transversal:
3. 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.
4. TEAMWORK - Level 3. Managing and making work groups effective. Resolving possible conflicts, valuing working with others, assessing the effectiveness of a team and presenting the final results.
5. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.
6. 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.

TEACHING METHODOLOGY

The hours of directed learning that are carried out in a large group, consist, on the one hand, in giving expository classes in which the teacher makes a brief presentation to introduce the general learning objectives related to the basic concepts of the subject, which are combined with cooperative learning techniques, in which the resolution of practical exercises is proposed from which it is tried to motivate and involve the students so that they participate actively in their learning. Students can access all the support material via ATENEA.

The hours of directed learning that are carried out in a small group, consist of carrying out laboratory practices, which are done in pairs, and allow the development of basic instrumental skills in an electronics laboratory, as well as initiating students in the application of the scientific method in problem solving.
In general, after each session, tasks are proposed outside the classroom, which must be worked either individually or in groups and which are the basis of autonomous learning. Other hours of autonomous learning must also be considered, such as those devoted to oriented reading, solving the proposed problems or self-learning questionnaires for the different contents through the virtual campus ATENEA.

LEARNING OBJECTIVES OF THE SUBJECT

Upon completion of the Electronic Instrumentation course, the student must be able to:
- Know and understand the operation of the main sensors and transducers.
- Correctly classify the transducers.
- Design amplifiers that allow measurements with transducers.
- Know and understand the operation of smart sensors.
- Know and understand the operation of data acquisition systems.
- Know and understand the operation of virtual instruments.
- Properly use modeling and simulation tools.
- Properly use data acquisition cards.
- Properly use the instrumentation software.

STUDY LOAD

Type	Hours	Percentage
Self study	90,0	60.00
Hours large group	45,0	30.00
Hours small group	15,0	10.00

Total learning time: 150 h

CONTENTS

Title content 1: INTRODUCTION TO ELECTRONIC INSTRUMENTATION

Description:
1.1. Measurement systems.
1.2. Static characteristics.
1.3. Dynamic characteristics.

Specific objectives:
- Understand the functions and types of a measurement system.
- Know the main characteristics of a measurement system.

Related activities:
Activity 1: Introduction to the Electronic Instrumentation Laboratory.
Activity 3: Individual evaluation test.
Activity 4: Individual evaluation test.

Full-or-part-time: 10h
Theory classes: 3h
Laboratory classes: 1h
Self study : 6h

Content title 2: TRANSDUCERS

Description:
2.1 Fundamental concepts of sensors and transducers.
2.2 Classification.
2.3 Types of sensors.
2.4 Types of transducers.
2.5 Applications.

Specific objectives:
- Understand and assimilate the basic concepts about the operation of sensors and transducers.
- Know and know how to classify the main sensors and transducers used in industrial applications.
- Analyze different types of sensors and transducers.
- Know various applications of sensors and transducers.
- Correctly interpret the specifications of the sensor and transducer manufacturers.

Related activities:
Activity 1: Introduction to the Electronic Instrumentation Laboratory.
Activity 2: Electronic Instrumentation Laboratory Practices.
Activity 3: Individual evaluation test.
Activity 4: Individual evaluation test.

Full-or-part-time: 40h
Theory classes: 12h
Laboratory classes: 4h
Self study : 24h

Title content 3: CONDITIONING CIRCUITS

Description:
3.1 Bridged amplifiers.
3.2 Instrumentation amplifiers.
3.3 Other amplifiers.

Specific objectives:
- Understand and assimilate the characteristics of bridge amplifiers.
- Understand and assimilate the characteristics of instrumentation amplifiers.
- Design different types of amplifiers.
- Know how to interpret the characteristics sheets of the main instrumentation amplifiers available on the market.

Related activities:
Activity 1: Introduction to the Electronic Instrumentation Laboratory.
Activity 2: Electronic Instrumentation Laboratory Practices.
Activity 4: Individual evaluation test.

Full-or-part-time: 30h
Theory classes: 9h
Laboratory classes: 3h
Self study : 18h

Title content 4: DATA ACQUISITION SYSTEMS

Description:
4.1. Introduction to data acquisition systems.
4.2. Configuration of a data acquisition system.
4.3. Smart sensors.
4.4. Data acquisition cards.
4.5. Instrumentation buses.

Specific objectives:
- Understand and assimilate the basic concepts of data acquisition systems.
- Know and classify the main types of data acquisition systems.
- Know and understand the operation of data acquisition cards.
- Correctly interpret the specifications of the data acquisition card manufacturers.

Related activities:
Activity 1: Introduction to the Electronic Instrumentation Laboratory.
Activity 2: Electronic Instrumentation Laboratory Practices.
Activity 4: Individual evaluation test.

Full-or-part-time: 40h
Theory classes: 12h
Laboratory classes: 4h
Self study : 24h

Title content 5: INSTRUMENTATION SOFTWARE

Description:
5.1. Digital instruments.
5.2. Instrumentation software.

Specific objectives:
- Understand and assimilate the basic concepts about the operation of digital instruments.
- Program correctly using instrumentation software.

Related activities:
Activity 1: Introduction to the Electronic Instrumentation Laboratory.
Activity 2: Electronic Instrumentation Laboratory Practices.
Activity 4: Individual evaluation test.

Full-or-part-time: 30h
Theory classes: 9h
Laboratory classes: 3h
Self study : 18h

ACTIVITIES

TITLE OF ACTIVITY 1: INTRODUCTION TO THE ELECTRONICS LABORATORY

Description:
Descriptive introductory activity without weight in the continuous assessment beyond the mandatory presence of the student to it, which serves to make the student aware of how the practices in this subject will be organized. It will explain the operation of the practices, the organization of the sessions, their evaluation and a brief description of the practices and the materials used in each one will be made. The group-class will be organized in groups of a maximum of 2 students (although they could also be done individually). The Atenea environment will be accessed to observe the disposition of the support materials and to specify the way in which the internship reports and other documents to be evaluated will be delivered.

Specific objectives:
Knowledge of the objectives foreseen in the Electronic Instrumentation practices.

Material:
Athena Virtual Campus.
Practice guide.
Bibliography.
Web links of interest.

Delivery:
Oral communication student / teacher.
Monitoring of the material available to the student in the Athena environment.
Control of attendance at the information session.
It does not count as part of the continuous assessment beyond the mandatory presence of the students to be assessed in the attitudinal part of the first practice to be developed, already organized according to the criteria established in this session.

Full-or-part-time: 1h
Laboratory classes: 1h

TITLE OF ACTIVITY 2: ELECTRONIC INSTRUMENTATION LABORATORY PRACTICES

Description:
These practical sessions serve for the student to reinforce and expand, in the laboratory, the concepts that are developed in the theoretical classes. The following sections are developed in the different practical sessions:

- Choice of transducers for specific applications.
- Study of the characteristics of industrial transducers and conditioners.
- Design and assembly of circuits with transducers, conditioners, data transmission and visualization.
- Study of data acquisition systems.
- Interpretation of the characteristics of the data acquisition cards.
- Design and assembly of virtual instrumentation systems.

The practices are organized into two main sections, each one with an initial dedication of half the time assigned to the laboratory practices and an initial weighting of 50% on the final grade for this part of the subject. This weighting of each part can be adjusted based on the actual final dedication to each of the parts.

- Design and assembly of an analog measurement system.
- Data acquisition systems.

Specific objectives:
- Use general concepts of Electronic Instrumentation to solve practical cases.
- Identify and describe the behavior of different transducers and sensors.
- Check the operation and analyze applications of different types of transducers.
- Properly use Electronic Instrumentation modeling and simulation tools.
- Interpret feature sheets from integrated circuit manufacturers and data acquisition cards
- Carry out circuit assemblies.
- Prepare internship reports in standard format.

Material:
Athena Virtual Campus.
Practice script.
Bibliography.
Web links of interest.

Delivery:
Previous and / or complementary studies.
Reports of practices.
Attendance at practice sessions.
Oral communication student / teacher.
It represents a part of the continuous evaluation (40%).

Full-or-part-time: 49h
Laboratory classes: 14h
Self study: 35h

TITLE OF ACTIVITY 3: WRITTEN TEST

Description:
Individual test in the classroom related to the learning objectives of the subject contents.

Specific objectives:
Evaluate the general achievement of the objectives of contents 1, 2 and 3.

Material:
Statement of the test delivered at the time of the test.

Delivery:
The resolved test is delivered to the teacher.
It represents a part of the continuous evaluation of the specific contents of the subject: 60%.

Full-or-part-time: 12h
Theory classes: 2h
Self study: 10h

GRADING SYSTEM

- Activity 2: Electronic Systems laboratory practices: 40%.
- Activity 3: Written test: 60%.

The qualification of the final test will replace, if it is higher, the results obtained in the evaluation of activity 3.

EXAMINATION RULES.

If any of the laboratory or continuous evaluation activities are not carried out, it will be valued at 0 points.
Carrying out the laboratory activities is a necessary condition to pass the subject.

BIBLIOGRAPHY

Basic:
- Pérez García, Miguel Angel. Instrumentación electrónica. Madrid: Thomson, 2014. ISBN 9788428337021.

Complementary:
- Paton, B. E. Sensors, transducers and labview. New Jersey: Prentice Hall, 1999.
- Short tutorial on VXI/MXI: application note 030 [on line]. Austin: National Instruments, 2010 [Consultation: 17/11/2020]. Available on: https://physics.bgu.ac.il/COURSES/SignalNoise/vxi_tutorial.pdf.
- Johnson, Gary W.; Jennings, Richard W. LabVIEW graphical programming: practical applications in instrumentation and control. 4th ed. New York: McGraw-Hill, 2006. ISBN 0071451463.

RESOURCES

Other resources:
Electronic component and equipment specification sheets available on the Internet.