Course guide
330108 - IE - Electronic Instrumentation

Last modified: 16/05/2026

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 2016). (Compulsory subject).
BACHELOR'S DEGREE IN AUTOMOTIVE ENGINEERING (Syllabus 2017). (Optional subject).

Academic year: 2026 **ECTS Credits:** 6.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: Delis Ramos, Francisco Manuel

Others:

PRIOR SKILLS

Knowledge of analog electronics: analog components and circuits.

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 subject continuously combines theoretical and practical aspects, individual and group work, directed and guided work, and autonomous work. Lectures, practical classes, use of the computer to do simulations or search for information, or exercise classes will be some of the methodologies that will be used to teach the contents. In this sense, and to the extent possible, an attempt will be made to reduce the weight of lectures and give more to other methodologies, more active, and that can allow more autonomous learning of the students. This, the autonomy of the students, is an important point that we want to develop and that will be worked on in the subject. In fact, the acquisition of this competence will not only be useful for passing the subject, but will have a much longer journey, since it will facilitate the adaptation of the future engineer to changing environments where the ability to learn and solve the problems that may arise will be an added value in their professional competence.

The subject also aims to promote group work. That is why students will be organized into groups of two to carry out different activities throughout the course. These group activities will mostly be carried out in the classroom, during laboratory hours, in the form of solving practical simulation or physical activities, and outside the classroom, through the preparation of the practical activities discussed above or the writing of reports on the work that has been done.

There will also be space for individual work. The carrying out of exercises, simulations, or the prior preparation of content to be developed in the face-to-face class by studying the subject's support material (notes, videos, simulations, etc.) and the subsequent resolution of questionnaires on the subject are focused on covering this aspect.

The structure of the subject will be organized on the basis of the virtual teaching-learning environment Atenea, where all the teaching material can be found and from where it will be monitored and evaluated. In this sense, a large part of the material used comes from different OCW (OpenCourseWare) from various universities. The OCWs are an excellent source of teaching resources that everyone can access, so they will also be available for consultation once the subject has been completed. Also, through Atenea, the activities to be done will be presented, doubts will be raised that need to be resolved through forums and, ultimately, it will serve as a common place of communication between students and teachers.

LEARNING OBJECTIVES OF THE SUBJECT

Upon completion of the Electronic Instrumentation course, the student must be able to:

- Show knowledge of the operation of the main sensors.
- Show knowledge of the main signal conditioning and adapter circuits.
- Analyze and design measurement circuits.
- Show knowledge of data acquisition systems.
- Use electronic modeling and simulation tools appropriately.
- Use data acquisition software appropriately.
- Use data acquisition cards appropriately.
- Analyze and design data acquisition and test applications.

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. Measuring systems
1.2 Static characteristics
1.3 Dynamic characteristics
1.4 Errors
1.5 Calibration

Specific objectives:
- Show knowledge of the structure of a measurement system.
- Show knowledge of the characteristics of measurement systems.

Related activities:
- Deliverables (LL). Questions on general characteristics of measurement systems.
- Practicals (PR). Potentiometric sensor.
- Written test (PEP1). Measurement systems and instrumentation circuits.

Full-or-part-time: 10h
Theory classes: 2h
Laboratory classes: 2h
Self study : 6h

Content title 2: TRANSDUCERS

Description:
2.1. Types of signals
2.2. Impedance bridges
2.3. Signal amplifiers
2.4. Signal converters
2.5. D/A converters
2.6. A/D converters
2.7. Filters
2.8. Analog multiplexers
2.9. Analog switches
2.10 Analog multiplexers
2.11 Sample and hold circuits

Specific objectives:
- Show knowledge of the different circuits and systems that make up a measurement system.
- Analyze and design circuits that are part of measurement systems.
- Analyze and design complete measurement systems.
- Interpret data sheets of electronic components.

Related activities:
- Delivery (LL). Questions on instrumentation circuits.
- Delivery (LL). Problems on linear and nonlinear circuits with operational amplifiers
- Delivery (LL). Filter design
- Practicals (PR). Potentiometric sensor.
- Practical (PR). Sensor system.
- Practical (PR). Data transmission system.
- Practical (PR). Data display system.
- Written Test (PEP1). Measurement systems and instrumentation circuits.

Full-or-part-time: 35h
Theory classes: 12h
Laboratory classes: 2h
Self study : 21h

Title content 3: CONDITIONING CIRCUITS

Description:
3.1 IC Semiconductors
3.2 Thermistors
3.3 RTD
3.4 Thermocouples

Specific objectives:
- Show knowledge about different temperature sensors.
- Analyze and design circuits with temperature sensors.
- Interpret temperature sensor data sheets.

Related activities:
- Assignments (LL). Questions about temperature sensors.
- Assignments (LL). Problems about temperature sensors.
- Practice (PR). Work on sensors
- Practice (PR). Sensor system.
- Practice (PR). Data transmission system
- Practice (PR). Data visualization system
- Practice (PR). Data visualization system
- Written Test (PEP2). Measurement of physical quantities.

Full-or-part-time: 15h
Theory classes: 4h
Laboratory classes: 2h
Self study : 9h

Title content 4: DATA ACQUISITION SYSTEMS

Description:
4.1. Potentiometric
4.2. Extensiometric gauges
4.3. Piezoelectric
4.4. capacitive
4.5. inductive
4.6. Hall Effect
4.7. Optics
4.8. Ultrasound

Specific objectives:
- Show knowledge about the different sensors of mechanical quantities.
- Analyze and design circuits with sensors of mechanical quantities.
- Interpret data sheets of sensors of mechanical quantities.

Related activities:
- Assignments (LL). Questions on mechanical magnitude sensors.
- Assignments (LL). Problems on mechanical magnitude sensors.
- Practice (PR). Work on sensors.
- Practice (PR). Sensor system.
- Practice (PR). Data transmission system
- Practice (PR). Data visualization system
- Written Test (PEP2). Measurement of physical magnitudes.

Full-or-part-time: 25h
Theory classes: 8h
Laboratory classes: 2h
Self study : 15h

5. DATA ACQUISITION SYSTEMS

Description:
5.1. Data Acquisition Software
5.2. Basic Data Acquisition Concepts
5.3. Data Acquisition and Control and Test Applications

Specific objectives:
- Show knowledge about the structure and characteristics of data acquisition systems.
- Create programs with data acquisition software.
- Create practical data acquisition application programs with the corresponding software

Related activities:
- Delivery (LL). Basic concepts about data acquisition.
- Delivery (LL). Initial programs with data acquisition software.
- Delivery (LL). Data acquisition exercises.
- Practicals (PR). Projects with data acquisition software.
- Practicals (PR). Data acquisition and test projects.

Full-or-part-time: 52h 30m
Theory classes: 15h
Laboratory classes: 6h
Self study : 31h 30m

ACTIVITIES

1. WHOLE GROUP ACTIVITIES IN THE CLASSROOM

Description:
Of different nature: master classes, clarification of doubts, correction of exercises, problem solving, electronic simulation, use of data acquisition software, ...

Specific objectives:
Those that are detailed in the specific objectives in the subject contents.

Material:
Athena Virtual Campus.

Delivery:
There is no direct link to the assessment, although during the sessions it is possible that related activities, such as assignments or practicals, may be carried out.

Full-or-part-time: 41h
Theory classes: 41h

2. DELIVERIES

Description:
The assignments can be exercises of different nature: short answers to questions posed, problems, simulations, search for sensor characteristics, description of components or circuits... The idea is that they are activities to be carried out continuously during the semester so that students have permanent contact with the subject.

Specific objectives:
Those that are detailed in the specific objectives in the subject contents.

Material:
Athena Virtual Campus.

Delivery:
Identified in the contents as LL.

The assignments will be assessed as delivered (OK), partially presented (PP) or not delivered (NP). The final assessment of the assignments will be from 0 to 10.

The assignments represent 5% of the final grade for the subject.

Full-or-part-time: 35h
Self study: 35h

3. PRACTICES

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

Specific objectives:
Those that are detailed in the specific objectives in the subject contents.

Material:
Available in the corresponding Atenea course

Delivery:
Identified in the contents as PR.

The practices will be assessed using rubrics that take into account the satisfaction of the practice specifications, the memory of the practice, the autonomy in the development of the assigned task and the group work. The final grade of the practices will be from 0 to 10.

The practices have a weight of 25% of the subject grade.

Full-or-part-time: 37h 30m
Practical classes: 15h
Self study: 22h 30m

name english

Description:
During the regular semester there will be 2 partial written tests: one in the middle, during the scheduled exam period according to the School's calendar, and another at the end of the semester (multiple choice, problem solving, description of specific topics, etc.). There will also be a final written test for students who have not passed the subject regularly.

VERY IMPORTANT:

- Punctuality is requested when taking the tests. Access will not be possible after 10 minutes.
- Students will be asked to leave their mobile phones out of reach and in airplane mode. Teachers may use a signal detector. If someone is detected using their mobile phone during the test, their exam will be collected, it will be assessed with a 0, the subject will be suspended and the case will be reported to the School, which will assess the sanction to be applied, including, depending on the severity, definitive expulsion from the center.

Specific objectives:
Those that are detailed in the specific objectives in the subject contents.

Material:
Material for preparing for the test available in the corresponding Atenea course. Test material available on the day of the test.

Delivery:
Identified in the contents as PE.

As already mentioned in the description, during the regular semester there will be 2 written tests, one halfway through and one at the end of the semester. They will be rated from 0 to 10. The duration of the tests will be 2 hours.

PEP1. Measurement systems and instrumentation circuits: 50% of the weight of the written tests in the regular semester.

PEP2: Measurement of physical quantities: 50% of the weight of the written tests in the regular semester.

Note partial written tests in the regular semester PEP= 0.5*PEP1 + 0.5*PEP2

In the event that the subject is not passed in the ordinary way, there will be the possibility of taking a final written test (PEF), to be carried out during the final exam period and will last 2 hours. This final exam will examine all the content taught in the subject during the semester. The final PE grade will be the highest score between the grade of the written tests in the regular semester (PEP) and the PEF.

The written tests (PE) represent 70% of the subject grade.

Full-or-part-time: 24h
Theory classes: 4h
Self study: 20h

GRADING SYSTEM

Any academic fraud, plagiarism or use or possession of unauthorised means in an assessment activity leads to a mark of zero (0) for the affected test or assignment. Furthermore, in accordance with the University's regulations, if disciplinary proceedings are initiated the subject is recorded as "Pending Assessment" until a decision is reached. These incidents are managed in accordance with the **Action Framework for Academic Integrity in Assessment at the UPC**.

The final grade for the subject will correspond to the weighted average of assignments, practicals and written tests, as follows:

COURSE FINAL GRADE = 0.05*LL + 0.25*PR + 0.7*PE

The subject will be considered passed when this final grade is equal to or greater than 5 points.

EXAMINATION RULES.

- If any of the activities are not completed, it will be assessed with a score of 0.
- It is not necessary to complete all the activities, but the final average of the subject must be equal to or greater than 5 points.
- Punctuality is requested for written tests. Access will not be possible after 10 minutes.
- In written tests, students will be asked to leave their mobile phones out of reach and in airplane mode. Teachers may use a signal detector. In the event that someone is detected using a mobile phone during the test, their exam will be collected, assessed with a 0, the subject will be suspended and the case will be reported to the School, which will assess the sanction to be applied, including, depending on the severity, definitive expulsion from the center.
- In group activities, all members do not have to receive the same grade. This will depend on the involvement of each member of the group in carrying out the activity, on the task that each member has done…
- To carry out the practical activities, each student must have, at least, a breadboard, a multimeter and an oscilloscope probe. It is also advisable to have a set of basic tools, such as a screwdriver, pliers and file.

BIBLIOGRAPHY

Basic:
- Pérez García, Miguel Angel et altri. Instrumentación electrónica. Madrid: Thomson, 2004. ISBN 9788428337021.
- Pérez García, Miguel Ángel. Instrumentación electrónica. Madrid: Paraninfo, 2014. ISBN 9788428337021.

Complementary:
- Creus Solé, Antonio. Instrumentación industrial [on line]. 8a ed. Barcelona: Marcombo, 2011 [Consultation: 01/07/2025]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=9767. ISBN 9788426718662.
- Lajara Vizcaíno, José Rafael; Pelegrí Sebastià, José. Labview: entorno gráfico de programación [on line]. 2a ed. Barcelona: Marcombo, 2011 [Consultation: 01/07/2025]. Available on: https://research-ebsco-com.recursos.biblioteca.upc.edu/c/ik5pvi/search/details/qi6hvjh7wv?db=nlebk. ISBN 9788426716965.

RESOURCES

Other resources:
In the Atenea environment of the subject, all the necessary material will be available to follow it correctly.