Universidad de Navarra

***Sistemas de Medida e Instrumentación (Ing.Gr.)***

*Guía docente 2026-27*

**INTRODUCTION**

**Brief description**

The objective is to provide the students with the skills needed to use measurement and instrumentation systems in industrial environments. Basic concepts include transducers, signal conditioning, data acquisition and processing. Practical work is key, including three projects on strain measurement, temperature control and laser metrology

**Title (Module/Subject)**:

- Ingeniería en Tecnologías Industriales (Bloque Especializado de Tecnologías Industriales/Mecánica)
- Ingeniería Mecánica (Bloque Especializado Mecánica/Diseño de Máquinas y Vehículos)

**Details**:

- **ECTS**: 6 ECTS
- **Course**: 3.rd course, 2.nd semester
- **Character**: Compulsory
- **Language**: Inglés

**Lecturers:**

- José Manuel Sanchez Moreno
- Asier López Barberena
- Reyes Elizalde González
- Eduardo Gómez Martín

**LEARNING OUTCOMES (Competencies)**

**INGENIERÍA EN TECNOLOGÍAS INDUSTRIALES**

CE24 - Conocimiento aplicado de sistemas y procesos de fabricación, metrología y control de calidad.

**INGENIERÍA MECÁNICA**

CE26 - Conocimiento aplicado de sistemas y procesos de fabricación, metrología y control de calidad.

CG3 - Conocimiento en materias básicas y tecnológicas, que les capacite para el aprendizaje de nuevos métodos y teorías, y les dote de versatilidad para adaptarse a nuevas situaciones.

# PROGRAM

The main objective is to familiarize the students with measurement and instrumentation techniques in the following topics:

- Strain gauge measurements

- Selection of sensors and transducers
- Signal conditioning: Wheatstone bridge, Cold junction for thermocouples, amplifiers, ...
- Use of data acquisition boards
- Calibration: sensitivity, hysteresis, accuracy, reproducibility, etc.

Theory covering these topics is distributed in the following lessons:

1. The general measurement system
2. Static characteristics of measurement system elements
3. The accuracy of measurement systems in the steady state
4. Dynamic characteristics of measurement systems
5. Signals and noise in measurement systems
6. Reliability, choice and economics of measurement systems
7. Sensors
8. Signal conditioning elements
9. Signal processing elements
10. Data acquisition

The subject has 3 practical works.

1. Measurement of strain and force. Strain gauges.
2. On-Off temperature control
3. Laser metrology

## ACTIVIDADES FORMATIVAS

**Several methods are combined in the course:**

- Lectures on the topics described in the program.
- Problems worked out in the classroom.
- 3 practical works at the laboratory.
- Personal study of the student.

**The student should:**

- Attend regularly to the lectures, taking part actively and making notes for his/her personal study.
- Attend the laboratory classes and write the reports concerning the practical works.
- Work the problems proposed in the classroom and give them back when required for their evaluation.
- Attend the final exam.

**The subject has 3 practical works**.

Students will have to perform them and write a report. Reports should answer the questions proposed in the Lab guide and should not repeat the theoretical background given in these documents.

1. Measurement of strain and force. Strain gauges. (Duration: 2 classes, 9 hours)

- Objective: Fabrication of a gauged cantilever beam system. Calibration and PC data acquisition
- Techniques: Strain gauge instrumentation, calibration, error estimation.
- Report: Experimental data treatment

2. On-Off temperature control, (Duration: 2 classes, 9 hours)

- Objetive: On-off control of air temperature in a closed chamber. Time response.
- Techniques: Pt resistance, thermocouples, signal conditioning, solid state interruptor.
- Report: Comparison of results between Pt resistance and K thermocouple

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3. Laser metrology (Duration: 2 classes, 9 hours)

- Objetive: Set up of a laser measurement system. Error estimation.
- Technique: Laser diode, light sensors, optical system, data acquisition
- Report: Comparison of scanning and direct light methods

**ASSESSMENT**

**ORDINARY CALL**

In order to pass the subject, it is compulsory to have a **minimum mark of 4** out of 10 in the **EXAM** (individual) and to complete the 3 project reports. These reports correspond to the practical work which is carried out in couples.

The final score is calculated as follows:

- exam: 30% final score
- reports: 70% final score

**EXTRAORDINARY CALL**

The same as in the ordinary call.

# HORARIOS DE ATENCIÓN

**Prof. José Manuel Sánchez Moreno (jsanchezm@ceit.es)**

- Office: CEIT building room: 106
- Meetings organized on demand.

# BIBLIOGRAFÍA

**Main bibliography**

1. Morris, A.S. and Langari, R. *Measurement and Instrumentation. Theory and Application*. Elsevier, 2012. Localízalo en la Biblioteca versión electrónica y papel
2. Morris, A. S. *Measurement and Instrumentation Principles.* 2001. *Localízalo en la Biblioteca* versión electrónica
3. Labview Manual. Students can find it at the Resources Section (Practical Work sub-section).

**Other references**

- Metrología. Practica de la medida en la industria / Aenor-- 1ª ed-- Madrid : Aenor, 1999.