

Course Unit	Electronics and Instrumentation	Field of study	Electronics and Automation
Bachelor in	Mechanical Engineering	School	School of Technology and Management
Academic Year	2023/2024	Year of study	3
Type	Semestral	Semester	1
Level	1-3	ECTS credits	6.0
Code	9123-759-3101-00-23		
Workload (hours)	162	Contact hours	T - TP 60 PL - TC - S - E - OT - O -

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

Name(s) of lecturer(s) José Alexandre de Carvalho Gonçalves

### Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:

- Analyze amplifying circuits based on operational amplifiers.
- Analyze the frequency response and to dimension passive and active filters. Identify and understand the functional blocks of the measurement chain: transduction, conditioning, A/D and D/A converter.
- Identify and understand the functional blocks of the measurement chain: transduction, conditioning, A/D and D/A converter.
- Select sensors for fundamental measurements according to the requirements of the application.
- Design signal conditioning blocks.
- Being able to analyze electronic circuits used as drivers for electromechanical actuators.
- Know the different types of electromechanical actuators and their applications.
- Develop applications based on microcontrollers for data acquisition and actuator control.

### Prerequisites

Before the course unit the learner is expected to be able to:

- Apply base concepts of Calculus and Algebra.

### Course contents

1. Analog electronics, Operational amplifiers and filters. Typical circuits. 2. Measurement chain: transducers, signal conditioning and A/D conversion. A/D and D/A converters. 3. Electronic circuits used as drivers for electromechanical actuators. 4. Electromechanical actuators and their applications. 5. Systems based on microcontrollers for data acquisition and actuator control.

### Course contents (extended version)

- Analog electronics
  - Operational amplifiers. Ideal and non-ideal characteristics. Main configurations.
  - Filtering: Dimensione and analysis of the frequency response.
- Data acquisition systems
  - Basic elements of the measurement chain.
  - Measurement principles. measurement errors.
  - Specification and classification of transducers for data acquisition applications.
- Signal conditioning
  - Amplification.
  - Filtering.
- Analog-digital and digital-analog conversion
  - Sampling concepts.
  - General aspects of D/A conversion. D/A converter characteristics. D/A conversion techniques.
- Electromechanical actuators and their applications.
  - DC-Motor, Servo-Motor and stepper Motor.
  - Application study.
- Acquisition and control applications based on micro-controllers apply.

### Recommended reading

- Sedra, Smith, Microelectronic Circuits, Oxford University Press, 1998
- Ramon Pallas-Areny, John G. Webster, Sensors and Signal Conditioning, John Wiley & Sons, 1993
- Kevin M. Daugherty, Analog-to-Digital Conversion: A Practical Approach, McGraw-Hill International Editions, 1995
- Jeremy Blum, Exploring-Arduino-Tools-and-Techniques-for-Engineering 2nd edition, John Wiley & Sons, 2019
- Robert H. Bishop, The Mechatronics Handbook, CRC Press, 2002

### Teaching and learning methods

Lecture classes (30 h): Theoretical concepts presentation. Presentation, analysis and discussion of some application examples. Problem-solving and laboratory classes (30 h): Exercises. Laboratory experiments and works. Non presential period (102 h): Study. Anticipated resolution of suggested problems.

### Assessment methods

- Alternative 1 - (Regular, Student Worker) (Final)
  - Practical Work - 40%
  - Final Written Exam - 60%

### Language of instruction

Portuguese, with additional English support for foreign students.

### Electronic validation

José Alexandre de Carvalho Gonçalves	José Luís Sousa de Magalhaes Lima	João da Rocha e Silva	José Carlos Rufino Amaro
05-10-2023	09-10-2023	16-10-2023	31-10-2023