

Course Unit	Electronics and Instrumentation	Field of study	Electronics and Automation
Bachelor in	Mechanical Engineering	School	School of Technology and Management
Academic Year	2022/2023	Year of study	3
Type	Semestral	Semester	1
Level	1-3	ECTS credits	6.0
Code	9123-759-3101-00-22		
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:

1. Analyze amplifying circuits based on operational amplifiers.
2. 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.

3. Identify and understand the functional blocks of the measurement chain: transduction, conditioning, A/D and D/A converter.
4. Select sensors for fundamental measurements according to the requirements of the application.
5. Design signal conditioning blocks.
6. Being able to analyze electronic circuits used as drivers for electromechanical actuators.
7. Know the different types of electromechanical actuators and their applications.
8. Develop applications based on microcontrollers for data acquisition and actuator control.

### Prerequisites

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

1. 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)

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

### Recommended reading

1. Sedra, Smith, Microelectronic Circuits, Oxford University Press, 1998
2. Ramon Pallas-Areny, John G. Webster, Sensors and Signal Conditioning, John Wiley & Sons, 1993
3. Kevin M. Daugherty, Analog-to-Digital Conversion: A Practical Approach, McGraw-Hill International Editions, 1995
4. Jeremy Blum, Exploring-Arduino-Tools-and-Techniques-for-Engineering 2nd edition, John Wiley & Sons, 2019
5. 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	Paulo Alexandre Vara Alves
04-10-2022	16-10-2022	17-10-2022	05-11-2022