

Course Unit	Robotics	Field of study	Automation
Master in	Electrical and Computers Engineering	School	School of Technology and Management
Academic Year	2023/2024	Year of study	1
Type	Semestral	Semester	2
Workload (hours)	162	Contact hours	T - TP 30 PL 30 TC - S - E - OT - O -
		Level	2-1 ECTS credits 6.0
		Code	5070-792-1204-00-23

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. Understand the concepts of robotics.
2. Understand the perception and actuation systems in the field of robotics.
3. Identify and apply existing robotic solutions for real-world problem solving.
4. Apply the methods that allow the navigation of mobile robots.
5. Known and understand the emerging tools and algorithms in robotics domain.
6. Design, simulate e implement applications based on prototyping and commercial robots.

### Prerequisites

Before the course unit the learner is expected to be able to:  
Apply the base concepts of electronics and embedded systems

### Course contents

- Introduction to robotics.
- Sensory Perception.
- Actuators for robotic systems.
- Robótica móvel
- Manipulators.
- Tools and emergent algorithms in the robotics domain, such as Machine Learning applied to Robotics, simulation environments, ROS operating system , prototyping based on 3D printing and battery management systems,
- Safety, Legislation and Standards.

### Course contents (extended version)

1. Introduction to robotics
  - Robotics concept
  - Robot configurations
  - Applications
  - Intelligent robotics concept
2. Sensory Perception
  - Sensors for mobile robots and manipulators
  - Sensor stochastic modelling
  - Sensor fusion techniques
3. Actuators to be applied in robotic systems
  - Modeling and control of DC motors, servo-motores and stepper motors.
4. Mobile robotics
  - Locomotion
  - Localization
  - Navigation
5. Manipulators
  - Direct and inverse kinematics
  - Industrial manipulator robot programming
  - Collaborative manipulator robot programming
6. Emergent Tools and algorithms in the robotics domain
  - Machine Learning applied to Robotics
  - Simulation environments
  - ROS operating system
  - Prototyping based on 3D printing
  - Battery management systems
7. Safety, Legislation and Standards

### Recommended reading

1. Siciliano, B., Khatib, O. (2016). Robotics and the Handbook. In: Siciliano, B., Khatib, O. (eds) Springer Handbook of Robotics. Springer Handbooks. Springer ISBN: 978-3-319-32552-1.
2. Bräunl, T. (2006). Mobile Robot Design and Applications with Embedded Systems, Springer. ISBN 978-3-540-34319-6.
3. Niku, S. B. (2019). Introduction to Robotics: Analysis, Control, Applications, Wiley Publisher, ISBN: 978-1-119-52760-2.
4. Siegwart, R. , Nourbakhsh I. R., Scaramuzza D. (2011). Introduction to Autonomous Mobile Robots (Intelligent Robotics and Autonomous Agents series), MIT Press., ISBN: 978-0-262-01535-6.
5. Quigley, M., Gerkey, B., Smart, W. D., (2016). Programming Robots with ROS - A Practical Introduction to the Robot Operating System, O'Reilly, ISBN: 978-1449323899.

### Teaching and learning methods

- Lectures devoted to theoretical concepts.
- Demonstration sessions of real problems using industrial, collaborative and mobile robots.
- Implementing of practical challenges, one in the form of a mobile robot competition and another devoted to manipulation, being this tasks done in class and in non-face-to-face hours.

**Assessment methods**

- Evaluation - (Regular, Student Worker) (Final, Supplementary, Special)
- Final Written Exam - 50% (A theoretical test will be mandatory.)
- Practical Work - 50% (The laboratorial works will have a classification, reflecting its level of achievement.)

**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 Paulo Ramos Teixeira	José Carlos Rufino Amaro
06-03-2024	06-03-2024	13-03-2024	16-03-2024