1. OVERVIEW

Subject area	Mobile Robotics
Degree	Bachelor's Degree in Computer Engineering
School/Faculty	School of Architecture, Engineering and Design
Year	Third
ECTS	6 ECTS
Type	Elective
Language(s)	Spanish
Delivery mode	On campus / Online
Semester	First semester
Year	2022 / 2023
Coordinating professor	Sergio Bemposta Rosende
Teacher	Sergio Bemposta Rosende

2. INTRODUCTION

In this subject area, the students will learn the principles for creating a small mobile robot, from the point of view of both the necessary hardware and software.

In short, they will build a mobile wheeled platform on top of which different basic sensors, such as ultra-sound or line followers, will be placed and they will finish with a complex sound system, such as Lidar systems or cameras.

They will work with small embedded systems such as microcontrollers in the early design stages, to end up with complex and distributed programming on computers to process the information. In addition, a parallel simulated version will always be carried alongside the real design.

3. SKILLS AND LEARNING OUTCOMES

Basic skills (CB, by the acronym in Spanish):

- CB1: Students have demonstrated knowledge and understanding of a study area originating from general secondary school education, and are usually at the level where, with the support of more advanced textbooks, they may also demonstrate awareness of the latest developments in their field of study.
- CB2: Students can apply their knowledge to their work or vocation in a professional manner and possess the skills which are usually evident through the forming and defending of opinions and resolving problems within their study area.
- CB3: Students have the ability to gather and interpret relevant data (usually within their study area) to form opinions which include reflecting on relevant social, scientific or ethical matters.
- CB5: Students have developed the learning skills necessary to undertake further study in a much more independent manner.
- CG6. Ability to conceive and develop centralised or distributed computer systems or architectures, integrating hardware, software and networks…

Transversal skills (CT, by the acronym in Spanish):

- CT11: Planning and time management: Ability to set objectives and choose the right means to fulfil them through efficient use of time and resources.

- CT14: Innovation/Creativity: Ability to propose and invent new, original solutions that contribute towards improving problem situations, including ideas from other contexts.

Specific skills (CE, by the acronym in Spanish):

- CE13: Knowledge, design and efficient use of the most appropriate data types and structures to solve a problem.
- CE17: Knowledge and application of the features, functionalities and structure of Distributed Systems, Computer Networks and the Internet and design and implement applications based on them.
- CE20: Knowledge and application of the fundamental principles and basic techniques of parallel, concurrent, distributed and real-time programming.

Learning outcomes (RA, by the acronym in Spanish):

- RA1: Identify the parts and different structures of a mobile and service robot.
- RA2: Discover the scope of robotics and its potential uses.
- RA3: Design the sensors and actuators of a mobile or service robot.
- RA4: Develop software solutions to control and simulate mobile robots.
- RA5: Use localization and mapping software tools for mobile robots.

The following table shows how the skills developed in the subject area match up with the intended learning outcomes:

Skills	Learning outcomes
CB1	RA1
CB1, CT11	RA2
CB1, CB3, CB5, CG6, CT14, CE13, CE17, CE20	RA3
CB1, CB5, CT14, CE20	RA4

4. CONTENTS

The contents of the subject area are as follows:

- Mobile robot structures
- Navigation and localization systems Autonomous Robot Planning
- Software platforms for mobile robotics
- Mobile robotics applications

5. TEACHING/LEARNING METHODS

The types of teaching/learning methods are as follows:

- MD2. Lectures, subjects of study and seminars. The “lectures” taught in the on-campus delivery mode are called subjects of study and seminars in the online delivery mode, and are conducted through readings on the topic, technical notes and webinars (which are recorded for students to access).
- MD3. Laboratory work: the laboratories will mainly be used in the on-campus delivery mode.
- MD4. a) Group research and/or b) group problem-solving. This learning method will be used for the development of both declarative and procedural knowledge. In method type a), a different topic will be assigned to each group to be investigated. Later, new groups will be formed with students who have all studied a different topic, and these new groups will be proposed comprehension and problem-solving activities. In method type b), a series of questions and short problem activities will be proposed to be solved in groups.

- MD7. Practical case studies. These will be used for the development of conditional knowledge. In the online delivery mode, case studies will be used to develop the practical contents of the subject through forums and seminars. This method is also applicable in the classroom for the on-campus modality.
- MD8. Fieldwork, conferences, visits to companies and institutions. These will be used for the development of conditional knowledge. In the on campus delivery mode, all these learning methods may be used, while in the online delivery mode, only conferences can be carried out, as they will be available for remote access in real time (via streaming technologies) or recorded and broadcast afterwards.

6. LEARNING ACTIVITIES

The types of learning activities, plus the amount of time spent on each activity, are as follows:

On campus:

Learning activity (AF, by the acronym in Spanish)	Number of hours
AF1: On-campus/online lectures, reading topics and complementary materials, implementation of activities carried out independently and collectively.	50 h
AF2: Work carried out in the classroom independently and in groups Case studies, problem solving, project development, simulation	25 h
AF3: Independent working	50 h
AF4: Tutorials, academic monitoring and assessment	25 h
TOTAL	**150 h**

Online:

Learning activity (AF, by the acronym in Spanish)	Number of hours
AF6: Independent reading on complementary topics and materials and implementation of activities carried out independently. Subsequently, asynchronous group discussion on the Campus Virtual forum, and online seminars with the synchronous e-learning tools on the Campus Virtual.	50 h
AF7: Work carried out on the Campus Virtual independently and in groups. Case studies, problem solving, project development, simulation	25 h
AF3: Independent working	50 h
AF8: Tutorials, academic monitoring and assessment through the Campus Virtual	25 h
TOTAL	**150 h**

7. ASSESSMENT

The assessment systems, plus their weighting in the final grade for the subject area, are as follows:

On campus:

Assessment system	Weighting
SE1: Objective tests: in-class assessable tasks carried out individually.	30%
AS2, AS3, AS6: Various classroom activities that can be delivered individually and/or in groups.	20%
AS2, AS3, AS6: Various tasks carried out outside the classroom: work, exercises, practice and mini-projects	20%
AS2, AS3, AS4, AS6. Skill-based aspects of participation in tasks carried out inside	30%

and outside of the classroom.	

Online:

Assessment system	Weighting
SE8: 2 Objective tests: in-class assessable tasks carried out individually.	60%
AS9, AS10, AS12: Various tasks carried out outside the classroom: work, exercises, practice and mini-projects. Deliverables carried out individually.	20%
AS9, AS10, AS12: Various tasks carried out outside the classroom: work, exercises, practice and mini-projects. Deliverables worked on in groups	15%
AS9, AS10, AS11, AS12. Skill-based aspects of participation in tasks carried out inside and outside of the classroom.	5%

On the Campus Virtual, when you open the subject area, you will find all the details of your assessable tasks and the deadlines and assessment procedures for each task.

7.1. Ordinary exam period

To pass the subject area in the ordinary exam period, you must:

- A grade of at least 5.0 out of 10.0 in all individual, group and laboratory tasks separately.
- A grade of at least 5.0 out of 10.0 in all knowledge, written or oral tests.
- 60% on-campus attendance.
- The grade in the ordinary exam period will appear as NP (No grade reported) if the student fails to submit any assessable task which counts towards the weighted average.

7.2. Extraordinary exam period (resits)

In the extraordinary exam period, you must deliver the activities indicated by the professor, which will be compulsory for all activities where 5 out of 10 has not been achieved individually. In addition, the following restrictions will apply:

- In the extraordinary exam period, there are no group activities, they are all to be carried out individually. Therefore, each member of the original group must deliver the activity individually.
- If you fail the in-person test, you must retake it under the same conditions as in the ordinary exam period.
- In the event that you pass the objective tests and you only have individual or group tasks to carry out in the extraordinary exam period, the professor will reserve the right to hold a face-to-face or online confrontation to defend any exercise that the professor considers appropriate to demonstrate the knowledge acquired.
- The grade in the extraordinary exam period will appear as NP (No grade reported) if the student fails to submit any assessable task which counts towards the weighted average.

8. TIMELINE

The timeline with submission dates for the assessable tasks in this subject area will be indicated in this section:

Assessable tasks	Date
Analysis of the robots around you	Week 1
Control of a motor with Arduino	Week 2
PID control of a motor	Week 3
Design of a mobile service robot	Week 5
Setting up Raspberry Pi with Ubuntu and ROS	Week 6
Programming a distance sensor service	Week 8

Programming a video sensor	Week 10
AI in mobile robots (application of neural network)	Week 12
Overall Knowledge Test	Week 16

The timeline may be subject to change for logistical reasons related to the activities. Students will be informed of any changes in due time and course.

9. BIBLIOGRAPHY

The recommended bibliography is indicated below:

Core:

- https://wiki.ubuntu.com/SpanishDocumentation

Specific:

- https://www.ros.org/
- http://wiki.ros.org/Documentation

10. DIVERSITY AWARENESS UNIT

Students with special educational needs: To ensure equal opportunities, curricular adaptations or adjustments for students with special educational needs will be outlined by the Diversity Awareness Unit (UAD, Spanish acronym).

As an essential requirement, students with special educational needs must obtain a report about the curricular adaptations/adjustments from the Diversity Awareness Unit by contacting unidad.diversidad@universidadeuropea.es at the beginning of each semester.

11. STUDENT SATISFACTION SURVEYS

Your opinion matters!

Universidad Europea encourages you to complete our satisfaction surveys to identify strengths and areas for improvement for staff, degrees and the learning process.

These surveys will be available in the survey area of your campus virtual or by email.

Your opinion is essential to improve the quality of the degree.

Many thanks for taking part.