Academic Year: (2022 / 2023) **Review date: 18-01-2023**

Department assigned to the subject:

Coordinating teacher: GUTIERREZ FERNANDEZ, ERIC

Type: Compulsory ECTS Credits : 6.0

Year : 1 Semester : 2

OBJECTIVES

This course is composed by two parts: robotics and electronics.
In the first half of the course, students will learn the basic concepts of robotics, which are required to gain understanding in more complex areas. Students will be encouraged to reflect on the impact and relevance of robotics. They will experience how to program a robot and develop applications that use sensors, actuators and a controller. Students will acquire general programming notions that can be applied in other fields.
Regarding the the second part of the subject, during the first two sessions the students will learn fundamental topics of electronics. Basic equations will be proposed, and the students will go towards the nominal performance of basic electronics components such as sensors, transistors, and operational amplifiers. Then two informatics sessions will take place. The students will make use of the previous knowledge acquired to simulate circuits. Finally, the last six sessions will take place in the electronics laboratory. The students will develop the circuit for a thermometer. They will work in teams and propose their own solutions. Knowledge related to amplification, analog circuit design and instrumentation will be acquired.

DESCRIPTION OF CONTENTS: PROGRAMME

ROBOTICS
Class 1: Introduction to robotics.
Definition of robots and classification. Presentation of basic concepts such as hardware and software, sensors and actuators, or controllers. What¿s the role of humans?
Class 2: Building our robot I
Students will get familiar with the robotic platform by assembling its components.
Class 3: Building our robot II
Introduction to Arduino, the language of the robot.
Class 4: Programming the robot I
Basic concepts of Arduino
Class 5: Programming the robot II
Reading the robot¿s sensors
Class 6: Programming the robot III
Using the robot¿s actuators
Class 7: Programming the robot IV
Implementation of the first controller, the robot¿s brain.
Class 8: Programming the robot V
Moving around safely
Class 9: Programming the robot VI
Modeling robot¿s behavior using states machines.
Class 10: Applications
Line follower: based on the information provided by its sensors, students will program the robot to follow a line in the floor.
Wall follower: a well-known strategy in robot navigation is to make the robot to follow the walls.
Class 11: Personal project I
Students will design and implement a new application to help the robot to find the exit of a maze. Discussion with the teacher and start working.
Class 12: Personal project II
Students will progress in the implementation of the maze project
Class 13: Personal project III
Students will progress in the implementation of the maze project
Class 14: Presentation of the final project and tour.
The first half of the class will be dedicated to the student presentations where they will explain their new robot application to the rest of the group. Finally, we will visit the laboratories of robotics where

students will have the opportunity to see, interact and understand the operation of state-or-the-art robots.

ELECTRONICS
Class 15. Foundations of circuits theory and electronics I. Basic equations and analysis of circuits with resistors and capacitors.
Class 16. Foundations of circuits theory and electronics II. Sensors, transistors, and operational amplifiers. Nominal performance.
Class 17. Circuit simulation I. LTSpice for circuit simulation: circuits with resistors and capacitors.
Class 18. Circuit simulation II. LTSpice for circuit simulation: circuits sensors, transistors and operational amplifiers.
Class 19. Personal project I. Basic instrumentation in the electronics laboratory.
Class 20. Personal project II. Thermometer implementation: front-end circuit.
Class 21. Personal project III. Thermometer implementation: signal conditioning I.
Class 22. Personal project III. Thermometer implementation: signal conditioning II.
Class 23. Personal project IV. Thermometer implementation: analog-to-digital conversion with Arduino.
Class 24. Personal project V. Thermometer implementation: improvements I.
Class 25. Personal project V. Thermometer implementation: improvements II.
Class 26. Personal project VI. Project description and discussion I.
Class 27. Personal project VI. Project description and discussion II.
Class 28. Scoring. Submission of final documentation. At the end of the class, the professor will show some examples of chips implemented in the Electronics Technology Department for data acquisition.

LEARNING ACTIVITIES AND METHODOLOGY

Assembling a robot. Students will have to work in pairs to assemble all the parts of a robot following the instructions given.
Discussions in working groups on relevant aspects of the course. Certain current topics on robotics will be proposed and they will be asked to first comment / analyze it in small groups and then present it to the class as a whole.
Design of a solution for a real problem. Students will work in pairs to design a solution to a given problem about how a robot works. They will make this design on paper to facilitate modifications according to the comments of other classmates or the teacher.
Programming a robot. The students, two by two, will have to complete a series of exercises that will allow them to control the functionalities of the robot used in the course.

Design and assembly of the circuit for the implementation of a thermometer. Simulation of the thermometer circuits and verification of its correct operation. The laboratory project will be carried out in teams and there will not be a manual, but it will be the students themselves who will propose ideas at the beginning of each class for the design of the different stages necessary to measure the output of a temperature sensor, condition the obtained signal and finally read it through the Arduino microcontroller. All this with the assistance of the teacher. At the end of the Electronics part, each team will show their circuit to the rest of the class and possible problems or improvements will be discussed.

ASSESSMENT SYSTEM

Week 7: evaluation of the Robotics part.
Week 14: evaluation of the Electronics part.

This course does not have a final exam as the evaluation is based on experiential activities.

Robotics practical work 50%
Practical work of Electronics 50%
Experimental work Robotics 50%
Experimental work Electronics 50%

BASIC BIBLIOGRAPHY

- Floyd, Thomas L. Electronic devices., Pearson Prentice Hall, 2008

- Maja J. Mataric The robotics primer, MIT Press, 2007. ISBN: 9780262633543

- Roland Siegwart, Illah Reza Nourbakhsh and Davide Scaramuzza Introduction to autonomous mobile robots, MIT Press, 2011