PERSONA CIÈNCIA EMPRESA
Universitat Ramon Llull

COURSE: MECHATRONICS AND ROBOTICS

SUBJECT FOCUS: Optional
MODULE: Professional Complements
STUDIES: Degree in Industrial Technologies Engineering (B.Eng)

GENERAL CHARACTERISTICS

Tipo: ☐ Basic training, ☐ Compulsory, ☑ Optional
☐ Final degree project, ☐ External Practices
Length: Semestral **Semestre/s**: 7
Number of credits ECTS: 4
Language: English

DESCRIPTION

BRIEF DESCRIPTION AND JUSTIFICATION

Mechatronics is an interdisciplinary field that integrates mechanics, electronics, robotics, computer and control to design, validate and test more efficient industrial solutions. Industrial manufacturing robots is an exponentially growing field as it allows for continuous flexible manufacturing which has an increasing demand in engineers to design, program and maintain these automated facilities.

In this course we will start with a brief introduction in the history of mechatronics and robotics as well as an overview of the designing steps of a mechatronic process. We will then proceed with a deeper look into the different applications where robots are being used and what are their future applications. Students will read state-of-the art publications and briefly explain how is the field evolving.

Next, we will delve into the different components of robots such as sensors and actuators and continue into studying how we can determine the movement equations for robots both applying direct and inverse kinematics. Last, we will look into how we can integrate computer vision and path planning into our mechatronic system to allow for autonomous robots.

The laboratory part of this subject will be based in programming different mechatronic components in Matlab and Simulink as well as learning how to program the Mitsubishi Robot using Ciros Programming and then we will test our simulated programs determine the efficiency of our deisgned process.

COMPETENCES

General

- **E2:** Ability to understand and apply basic technical knowledge such as: mechanics, electronics, computer science and mathematics required for the practice of industrial engineering.
- **T1, T8**: Ability to read current scientific publications (T8) and explain them orally to other students (T1).
- **T2:** Class will be taught in English and the students will have to understand and communicate in English.

Module specific

- **CP4:** The students will learn techniques and methods that will be needed for automated industry.
- **CP5:** Ability to observe and analyze the problem that needs to be solved applying a mechatronic solution using all the knowledge acquired in the degree.

PREREQUISITES

The competences of the previous educational stages

CONTENTS

1. Introduction to mechatronics and robotic systems
1.1. Robot anatomy
1.2. Computational motion planning
1.3. Mechatronic design process
2. Overview of industrial, service and mobile robots
3. Sensors and actuators
4. Kinematics and statics for robotics
4.1. Direct and inverse kinematics
4.2. Differential kinematics and statics
5. Modeling of mechatronic systems
6. Introduction to computer vision and path planning
7. Simulation and programming of robotic systems
7.1. Programming with Matlab and Simulink
7.2. Introduction to simulation software

METHODOLOGY

LEARNING ACTIVITIES*

Learning activities	Credits ECTS	Competences
Lectures and sessions for resolution of exercises and problems (A1)	1,5	E2, T8, CP5
Practical work/laboratories (A5)	0,50	E2, T8, CP4, CP5
Personal study activities by students (A7)	1,5	E1E2, T8, CP5
Evaluation activities (A8)	0,25	E2
Oral and writing presentations (A9)	0,25	T1, T2, T8
TOTAL	4,00	E2, T1, CP5, CP8

EXPLANATION OF THE TEACHING METHODOLOGY

- **Lectures** - Presentation and explanation of contents by a teacher (possibly including demonstrations).
- **Case and Problem-Solving Sessions** - Resolution of exercises and problems, and exposition / discussion of cases by a teacher with the active participation of students.
- **Seminars** - Period of instruction carried out by a teacher with the aim of reviewing, discussing and resolving doubts about the materials and topics presented in the lectures and in the case and problem-solving sessions.
- **Practical and Lab** - Period where the student performs laboratory activities or similar (computer practices, projects, workshops, etc.) under the direct supervision of a teacher.
- **Presentations** - Oral presentation by a student to a teacher and/or other students. The presentation can be a work prepared by the student through searches in published bibliography, or a summary of a practical work or a project.
- **Personal study activities** - Personal work of the student necessary to acquire the competences of each subject matter, and to assimilate the knowledge exposed in lectures and case and problem-solving sessions, using the recommended reference materials. They also include the preparation of tasks related to the other activities, and the preparation of exams.
- **Assessment Tasks** - Oral and / or written tests made during the academic period of a course, or once it has finished (final exams, follow-up controls).

ASSESSMENT

ASSESSMENT METHODS

Assessment methods	Weight	Competences
Final exam (A)*	35%	E2, CP5
Partial exam (B)*	15%	E2, CP5
Classroom activities (C)	10%	E2,CP5
Exercises outside of class (D)	10%	E2
Oral Presentation (E)	10%	E2, T1,T2
Laboratory work and reports (F)	18%	E2, T8, CP4
Participation (G)	2%	

*In order to pass the course, both grades must be higher than 4.0 out of 10.0

Learning outcomes

- The student must demonstrate the ability to name the components of a robot as well as its mains used in the industry (A,B).
- The student must demonstrate the ability to calculate the static and kinematic equations of simple robotics system (A,B,C,D).

- The student must demonstrate the ability to simulate using Matlab, Simulink and Ciros Programming different mechatronic components and to optimize industrial processes using diferente robots (C,D,F).
- The students must be capable of researching state-of-the-art publications and to share the knowledge to other students in class (E).

QUALIFICATION

The evaluation of the course will consider all the deliverables shown in the evaluation table with their corresponding weights.

A large part of the evaluation will be obtained in the final exam (A) 35% (with a minimum grade of 5 out of 10) and will be added to the mark obtained during the course with: partial evaluations (B) 15%. Additionally, 30% of the classroom grade will be split between in-class activities (10%, C), exercises outside of class (10%, D) and an oral presentation (10%, E). The remaining 20% will be split between laboratories (18%, F), and participation in class (2%, G).

ASSESSMENT OF COMPETENCES

For the competences subject evaluation E2, T8 and CP5, will be used subsections of each one of the deliverables that the student will realize during the course. In each deliverable, part of the grade will reflect the ability to display the concepts mechanics, electronics and computer science (E2). For competences T1 and T2, the oral presentation will have a part of the grade for English proficiency and oral communication. Last, the laboratory section of this course will consider competences CP4 and CP5 and will take them into consideration for grading purposes.

BIBLIOGRAPHY

- K.M. Lynch, F.C. Park, “Modern Robotics; Mechanics, planning and control”, 2017, Cambridge University Press, ISBN 9781107156302
- W. Bolton, “Mechatronics: Electronic control systems in mechanical and electrical engineering, 7º Edition, Pearson education, ISBN: 978-1292250977
- D.G. Alciatore, M.B. Histand, “Introduction to mechatronics and measurement systems”, 4º Edition, Mc-Graw Hill ISBN: 978-0073380230
- T.R. Kurfess, “Ropbotics and Automation handbook”, 2005, CRC Press ISBN 0-8493-1804-1

DOCUMENT HISTORY

LAST REVISION
January 25, 2019, Joan Fernández Esmerats, PhD