

## [GJH104] ROBOTIC SYSTEMS AND ARTIFICIAL VISION

### GENERAL INFORMATION

<b>Studies</b>	DEGREE IN MECHATRONICS ENGINEERING		<b>Subject</b> ?
<b>Semester</b>	1	<b>Course</b>	4
<b>Character</b>	COMPULSORY		<b>Mention / Field of specialisation</b>
<b>Plan</b>	2020	<b>Modality</b>	Adapted Face-to-face
<b>Credits</b>	4,5	<b>Hours/week</b>	3.75
		<b>Language</b>	ENGLISH
		<b>Total hours</b>	67.5 class hours + 45 non-class hours = <b>112.5 total hours</b>

### PROFESSORS

IZAGUIRRE ALTUNA, ALBERTO  
 ANDONEGI ARTEGUI, IMANOL  
 ZUBIETA ANSORREGUI, JON

### REQUIRED PREVIOUS KNOWLEDGE

Subjects	Knowledge
FUNDAMENTALS OF COMPUTING SCIENCE MATHEMATICS I MATHEMATICS II	(No previous knowledge required)

### SKILLS

#### VERIFICA SKILLS

#### SPECIFIC

**GJCE19** - Knowledge of principles and applications of robotic systems

#### GENERAL

**GJCG03** - Addressing and optimising activities of assembly, commissioning, assistance and maintenance of facilities, machinery, and industrial mechatronic systems

**GJCG06** - Implement and materialize projects of automation and control of equipment, processes and flexible industrial systems, through the integration of hardware and software in order to optimize the operation of the different units that make up the system to meet the needs of the productive sector

#### BASIC

**G\_CB1** - To have proven to understand and have knowledge in a field of study based on general secondary education at a level found in advanced textbooks and including concepts at the forefront of their field of study.

### LEARNING RESULTS

**RGJ410** They design, apply and validate an artificial vision system for an industrial application.

#### LEARNING ACTIVITIES

	CH	NCH	TH
Individual study and work, tests and evaluations and check points	2 h.		2 h.
Presentation of the teacher in the classroom, in participatory classes, of concepts and procedures associated with the subjects	10 h.	5 h.	15 h.
Individual and team exercises	7 h.	3 h.	10 h.

#### EVALUATION SYSTEM

Written, coding/programming and individual oral tests for the evaluation of technical skills in the field

W

100%

#### MAKE-UP MECHANISMS

Individual written and oral tests to assess technical skills of the subject

**CH - Class hours:** 19 h.

**NCH - Non-class hours:** 8 h.

**TH - Total hours:** 27 h.

**RGJ411** They simulate, use and program robots in industrial applications.

#### LEARNING ACTIVITIES

	CH	NCH	TH
Individual study and work, tests and evaluations and check points	2 h.		2 h.
Presentation of the teacher in the classroom, in participatory classes, of concepts and	20 h.	5,5 h.	25,5 h.

procedures associated with the subjects

Individual and team exercises

14 h.

14 h.

28 h.

**EVALUATION SYSTEM**

*W*

Written, coding/programming and individual oral tests for the evaluation of technical skills in the field

100%

**MAKE-UP MECHANISMS**

Individual written and oral tests to assess technical skills of the subject

**CH - Class hours:** 36 h.

**NCH - Non-class hours:** 19,5 h.

**TH - Total hours:** 55,5 h.

**RGJ412** They obtain the kinematic model of a robot with n degrees of freedom. Programming of an industrial robot based on information acquired through an artificial vision system.

**LEARNING ACTIVITIES**

*CH*

*NCH*

*TH*

Development, writing and presentation of memorandums, reports, audiovisual material, etc.  
Relating to projects/POPBLs carried out individually or in teams

6 h.

12 h.

18 h.

**EVALUATION SYSTEM**

*W*

Technical skills, involvement in the project, finished work, obtained results, handed documentation, presentation and technical defence

100%

**MAKE-UP MECHANISMS**

Technical skills, involvement in the project, finished work, obtained results, handed documentation, presentation and technical defence

**Comments:** Continuous assessment. Retake is not foreseen.

**CH - Class hours:** 6 h.

**NCH - Non-class hours:** 12 h.

**TH - Total hours:** 18 h.

**RGJ414** They assume responsibilities in the team, organizing and planning the tasks to be developed, dealing with contingencies and encouraging the participation of its members.

**LEARNING ACTIVITIES**

*CH*

*NCH*

*TH*

Development, writing and presentation of memorandums, reports, audiovisual material, etc.  
Relating to projects/POPBLs carried out individually or in teams

1 h.

2 h.

3 h.

**EVALUATION SYSTEM**

*W*

Technical skills, involvement in the project, finished work, obtained results, handed documentation, presentation and technical defence

100%

**MAKE-UP MECHANISMS**

Technical skills, involvement in the project, finished work, obtained results, handed documentation, presentation and technical defence

**Comments:** Continuous assessment. Retake is not foreseen.

**CH - Class hours:** 1 h.

**NCH - Non-class hours:** 2 h.

**TH - Total hours:** 3 h.

**RGJ415** They analyze the variables involved in the problem and propose actions for a stable situation.

**LEARNING ACTIVITIES**

*CH*

*NCH*

*TH*

Development, writing and presentation of memorandums, reports, audiovisual material, etc.  
Relating to projects/POPBLs carried out individually or in teams

2 h.

1 h.

3 h.

**EVALUATION SYSTEM**

*W*

Technical skills, involvement in the project, finished work, obtained results, handed documentation, presentation and technical defence

100%

**MAKE-UP MECHANISMS**

Technical skills, involvement in the project, finished work, obtained results, handed documentation, presentation and technical defence

**Comments:** Continuous assessment. Retake is not foreseen.

**CH - Class hours:** 2 h.
   
**NCH - Non-class hours:** 1 h.
   
**TH - Total hours:** 3 h.

**RGJ416** They define the problem, the development of the solution, as well as the conclusions in an effective way, arguing and justifying each of them, making a correct use of the language, in writing.

**LEARNING ACTIVITIES**

	<i>CH</i>	<i>NCH</i>	<i>TH</i>
Development, writing and presentation of memorandums, reports, audiovisual material, etc.	1,5 h.	1,5 h.	3 h.
Relating to projects/POPBLs carried out individually or in teams			

**EVALUATION SYSTEM**

*W*

Technical skills, involvement in the project, finished work, obtained results, handed documentation, presentation and technical defence

**MAKE-UP MECHANISMS**

Technical skills, involvement in the project, finished work, obtained results, handed documentation, presentation and technical defence

**Comments:** Continuous assessment. Retake is not foreseen.

**CH - Class hours:** 1,5 h.
   
**NCH - Non-class hours:** 1,5 h.
   
**TH - Total hours:** 3 h.

**RGJ417** They define the problem, the development of the solution, as well as the conclusions in an effective way, arguing and justifying each one of them, and making a correct use of the language, orally.

**LEARNING ACTIVITIES**

	<i>CH</i>	<i>NCH</i>	<i>TH</i>
Development, writing and presentation of memorandums, reports, audiovisual material, etc.	2 h.	1 h.	3 h.
Relating to projects/POPBLs carried out individually or in teams			

**EVALUATION SYSTEM**

*W*

Technical skills, involvement in the project, finished work, obtained results, handed documentation, presentation and technical defence

**MAKE-UP MECHANISMS**

Technical skills, involvement in the project, finished work, obtained results, handed documentation, presentation and technical defence

**Comments:** Continuous assessment. Retake is not foreseen.

**CH - Class hours:** 2 h.
   
**NCH - Non-class hours:** 1 h.
   
**TH - Total hours:** 3 h.

**CONTENTS**

**Industrial robot programming and simulation**

- Basics about the simulation environment.
- Cartesian reference systems: pose and frame transformations.
- Targets and paths. -Creating and calibrating a new tool on an industrial robot.
- Programming robots using scripting language.
- Socket communication.

**Computer vision:**

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- Introduction to cameras and images.
  - Image filtering, thresholding, convolutional filters.
  - Morphological operations.
  - 2D metrology.
  - Programming a camera assisted robotic system.

## LEARNING RESOURCES AND BIBLIOGRAPHY

Learning resources	Bibliography
Labs	ABB Robotics Technical reference manual RAPID Instructions, Functions and Data types (Online, fopen access)
Moodle Platform	ABB Robotics Operating manual RobotStudio (Online, open access).
Class presentations	Richard Szeliski - Computer Vision Algorithms and Applications Rafael C. Gonzalez and Richard E. Woods - Digital Image Processing 4th Ed. MVTEC Halcon Documentation - (Online, open access) John J. Craig. introduction to Robotics: Mechanics and Control. Pearso, 3rd editon. 2005 <a href="http://katalogoa.mondragon.edu/janium-bin/janium_login_opac_re_Ink.pl?grupo=MECATRONICA41&amp;ejecuta=10&amp;_ST">http://katalogoa.mondragon.edu/janium-bin/janium_login_opac_re_Ink.pl?grupo=MECATRONICA41&amp;ejecuta=10&amp;_ST</a>