# [GJH304] ROBOTIC SYSTEMS AND ARTIFICIAL VISION

## GENERAL INFORMATION

| | | | | | |
|---|---|---|---|---|---|
| **Studies** | DEGREE IN MECHATRONICS ENGINEERING | | | **Subject** | ? |
| **Semester** | 1 | **Course** | 4 | **Mention / Field of specialisation** | |
| **Character** | COMPULSORY | | | | |
| **Plan** | 2025 | **Modality** | Face-to-face | **Language** | EUSKARA/CASTELLANO/ENGLISH |
| **Credits** | 6 | **Hours/week** | 5 | **Total hours** | 90 class hours + 60 non-class hours = **150 total hours** |

## 2030 AGENDA GOALS


## PROFESSORS

ALONSO NIETO, MARCOS
SESAR GIL, IÑIGO
DOK-SEIJO BARQUIN, IRAIDE

## REQUIRED PREVIOUS KNOWLEDGE

| Subjects | Knowledge |
|---|---|
| FUNDAMENTALS OF COMPUTING SCIENCE<br>MATHEMATICS II<br>MATHEMATICS I | *(No previous knowledge required)* |

## LEARNING RESULTS

| LEARNING RESULTS | KC | SK | AB | ECTS |
|---|---|---|---|---|
| **GJR414** - To know and apply the principles of robotic systems and artificial vision | | | x | 5,36 |
| **G-TR1** - To develop interdisciplinary projects specific to their specialty and of gradual complexity, - becoming aware of respect for human rights and fundamental rights, and analyzing and assessing the impact of the proposed solutions on the SDGs - to acquire and/or apply basic, advanced and/or avant-garde, demonstrating the ability to work in multidisciplinary teams and/or undertake further studies with a high degree of autonomy | | x | | 0,32 |
| **G-TR2** - To express information, ideas and the arguments that support them in an orderly, clear and coherent manner, orally and in writing, based on quality information, self-made or obtained from different sources, using inclusive and non-discriminatory language | | x | | 0,32 |
| | | | **Total:** | 6 |

*KC: Knowledge or Content / SK: Skills / AB: Abilities*

## SECONDARY LEARNING RESULTS

**RGJ412** **Identify and demonstrate the basic fundamentals of artificial vision.**

| LEARNING ACTIVITIES | CH | NCH | TH |
|---|---|---|---|
| Presentation by the teacher in the classroom, in participatory classes, of concepts and procedures associated with the subjects | 8 h. | 8 h. | 16 h. |
| Carrying out exercises and solving problems individually and/or in teams | 16 h. | 13 h. | 29 h. |
| Practical work in workshops and/or laboratories, individually and/or in teams | 15 h. | 13 h. | 28 h. |

| EVALUATION SYSTEM | W |
|---|---|
| Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems | 20% |
| Presentation and defence of exercises, case studies, computer practical work, simulation practical work, laboratory practical work, term projects, end of degree project, master's thesis, challenges and problems | 80% |

**MAKE-UP MECHANISMS**

Individual written and/or oral tests or individual coding/programming tests

**CH - Class hours:** 39 h.
**NCH - Non-class hours:** 34 h.
**TH - Total hours:** 73 h.

**RGJ410** **Design, implement, and validate a robotic handling system equipped with artificial vision for an industrial application.**

| LEARNING ACTIVITIES | CH | NCH | TH |
|---|---|---|---|
| Carrying out/resolving projects/challenges/cases, etc. to provide solutions to problems in interdisciplinary contexts, real and/or simulated, individually and/or in teams | 10 h. | 3 h. | 13 h. |

| EVALUATION SYSTEM | W |
|---|---|
| Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems | 25% |
| Presentation and defence of exercises, case studies, computer practical work, simulation practical work, laboratory practical work, term projects, end of degree project, master's thesis, challenges and problems | 25% |
| Individual written and/or oral tests or individual coding/programming tests | 50% |

**MAKE-UP MECHANISMS**

Presentation and defence of exercises, case studies, computer practical work, simulation practical work, laboratory practical work, term projects, end of degree project, master's thesis, challenges and problems

**CH - Class hours:** 10 h.
**NCH - Non-class hours:** 3 h.
**TH - Total hours:** 13 h.

**RGJ491** **Coordinate the work team, fostering cohesion and a positive atmosphere to achieve the integration of all individuals and their contribution to achieving appropriate performance, both individually and as a group, for the development of the project.**

| LEARNING ACTIVITIES | CH | NCH | TH |
|---|---|---|---|
| Carrying out/resolving projects/challenges/cases, etc. to provide solutions to problems in interdisciplinary contexts, real and/or simulated, individually and/or in teams | 2 h. | 2 h. | 4 h. |

| EVALUATION SYSTEM | W |
|---|---|
| Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems | 100% |

**MAKE-UP MECHANISMS**

*(No mechanisms)*

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

**CH - Class hours:** 2 h.
**NCH - Non-class hours:** 2 h.
**TH - Total hours:** 4 h.

**RGJ493** **Prepare the project report, providing detailed arguments and using language that is correct, inclusive, and non-discriminatory.**

| LEARNING ACTIVITIES | CH | NCH | TH |
|---|---|---|---|
| Development and writing of records, reports, presentations, audiovisual material, etc. on projects/work experience/challenges/case studies/experimental investigations carried out individually and/or in teams | 2 h. | 2 h. | 4 h. |

| EVALUATION SYSTEM | W |
|---|---|
| Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems | 100% |

**MAKE-UP MECHANISMS**

*(No mechanisms)*

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

**CH - Class hours:** 2 h.
**NCH - Non-class hours:** 2 h.
**TH - Total hours:** 4 h.

**RGJ411** **Identify and demonstrate the basic fundamentals of industrial robotics.**

| LEARNING ACTIVITIES | CH | NCH | TH |
|---|---|---|---|
| Computer simulation exercises, individually and/or in teams | 8 h. | 4 h. | 12 h. |
| Presentation by the teacher in the classroom, in participatory classes, of concepts and procedures associated with the subjects | 7 h. | 4 h. | 11 h. |
| Carrying out exercises and solving problems individually and/or in teams | 18 h. | 7 h. | 25 h. |

| EVALUATION SYSTEM | W | MAKE-UP MECHANISMS |
|---|---|---|
| Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems | 80% | Individual written and/or oral tests or individual coding/programming tests |
| Presentation and defence of exercises, case studies, computer practical work, simulation practical work, laboratory practical work, term projects, end of degree project, master's thesis, challenges and problems | 20% | |

**CH - Class hours:** 33 h.
**NCH - Non-class hours:** 15 h.
**TH - Total hours:** 48 h.

**RGJ490** **Define and manage the objectives and planning of a project that allows you to acquire and/or reinforce knowledge of specific technologies in your field of expertise—which are sometimes at the cutting edge of knowledge—and define a strategy.**

| LEARNING ACTIVITIES | CH | NCH | TH |
|---|---|---|---|
| Carrying out/resolving projects/challenges/cases, etc. to provide solutions to problems in interdisciplinary contexts, real and/or simulated, individually and/or in teams | 2 h. | 2 h. | 4 h. |

| EVALUATION SYSTEM | W | MAKE-UP MECHANISMS |
|---|---|---|
| Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems | 100% | *(No mechanisms)*<br>**Comments:** Continuous assessment. Retake is not foreseen. |

**CH - Class hours:** 2 h.
**NCH - Non-class hours:** 2 h.
**TH - Total hours:** 4 h.

**RGJ494** **Give an oral presentation of the project, justifying the proposed solutions with detailed and precise arguments, and using language that is correct, inclusive, and non-discriminatory.**

| LEARNING ACTIVITIES | CH | NCH | TH |
|---|---|---|---|
| Development and writing of records, reports, presentations, audiovisual material, etc. on projects/work experience/challenges/case studies/experimental investigations carried out individually and/or in teams | 2 h. | 2 h. | 4 h. |

| EVALUATION SYSTEM | W | MAKE-UP MECHANISMS |
|---|---|---|
| Presentation and defence of exercises, case studies, computer practical work, simulation practical work, laboratory practical work, term projects, end of degree project, master's thesis, challenges and problems | 100% | *(No mechanisms)*<br>**Comments:** Continuous assessment. Retake is not foreseen. |

**CH - Class hours:** 2 h.
**NCH - Non-class hours:** 2 h.
**TH - Total hours:** 4 h.

## CONTENTS

**Basic concepts of robot simulation and programming**

-Fundamentals of the simulation environment.

-Fundamentals of relative position and orientation and transformations between different Cartesian reference systems. -Basic programming of an industrial robot, points and trajectories. -Definition and calibration of a tool embedded in a robot. -Fundamentals of programming in the robot's specific programming language. -Socket programming. **Artificial vision**
-Fundamentals of images and cameras. -Image filtering. -Morphological operators. -2D metrology.

## 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 |