Teaching Guide				
Identifying Data				2023/24
Subject (*)	Intelligent Robotics I		Code	614544019
Study programme	Máster Universitario en Intelixencia Artificial			
Descriptors				
Cycle	Period	Year	Type	Credits
Official Master's Degree	1st four-month period	First	Obligatory	3
Language	English			
Teaching method	Face-to-face			
Prerequisites				
Department	Ciencias da Computación e Tecnoloxías da Información			
Coordinador	Bellas Bouza, Francisco Javier	E-mail	francisco.bellas@udc.es	
Lecturers	Bellas Bouza, Francisco Javier	E-mail	francisco.bellas@udc.es	
Web				
General description	The main objective of this subject is to provide the conceptual bases of intelligent robotics, that is, how AI techniques apply to the particular case of robots with the aim of achieving autonomous operation. All the development of the subject is based on the distinctive properties of robotics, such as operation in real environments and the existence of a physical body. Based on these premises, the subject covers fundamental aspects of sensing, action and control, with a practical approach towards the resolution of problems autonomously by the robot.			

Study programme competences / results	
Code	Study programme competences / results
A18	CE17 - Understanding and assimilation of the capacities and limitations of intelligent robotic systems, together with the technologies supporting them
A19	CE18 - Building up the ability to choose, design and implement AI based strategies to provide robotic systems, both individual and collective, with the capacities required to perform their tasks in a suitable way, according to the goals and constraints to be taken into account
B1	CG01 - Maintaining and extending theoretical foundations to allow the introduction and exploitation of new and advanced technologies in the field of AI
B2	CG02 - Successfully addressing each and every stage of an AI project
B3	CG03 - Searching and selecting that useful information required to solve complex problems, with a confident handling of bibliographical sources in the field
B6	CB01 - Acquiring and understanding knowledge that provides a basis or opportunity to be original in the development and/or application of ideas, frequently in a research context
B7	CB02 - The students will be able to apply the acquired knowledge and to use their capacity of solving problems in new or poorly explored environments inside wider (or multidisciplinary) contexts related to their field of study
B9	CB04 - The students will be able to communicate their conclusions, their premises and their ultimate justifications, both to specialised and non-specialised audiences, using a clear style language, free from ambiguities
C3	CT03 - Use of the basic tools of Information and Communications Technology (ICT) required for the student's professional practice and learning along her life
C5	CT05 - Understanding the importance of the entrepreneurial culture and knowledge of the resources within the entrepreneur person's means
C7	CT07 - Developing the ability to work in interdisciplinary or cross-disciplinary teams to provide proposal that contribute to a sustainable environmental, economic, political and social development
C8	CT08 - Appreciating the importance of research, innovation and technological development in the socioeconomic and cultural progress of society

Learning outcomes

Learning outcomes	Study programme competences / results		
To know the elements of a robotic system at hardware and software level, and to understand the basics of Artificial Intelligence applied to robots (embodiment, real world, real time).	AC17	BC1 BC3	CC8
To know the operating principles of the different types of sensors and actuators adapted to the different operating environments.	AC17	BC1 BC6	CC3 CC8
To have an overview of the different traditional control techniques in intelligent robots, as well as the technologies that support them.	AC18	BC3	CC8
Develop an autonomous control system for operation in a simulated or real environment.	AC18	BC2 BC7 BC9	CC5 CC7

Contents	
Topic	Sub-topic
Elements of an Intelligent Robotic System	Robotics and Artificial Intelligence Environment, embodiment and reality gap Design of autonomous robots
Sensing and actuation.	Distance sensors, inertial sensors, cameras, microphones Actuators and effectors Degrees of freedom Motors, displays, speakers Communications Natural interaction
Knowledge based robotics (deliberative)	Knowledge representation Classical control architectures Navigation (locomotion)
Behavior based robotics (reactive)	Rule-based systems Fuzzy logic Subsumption architectures
Hybrid approaches	Main architectures Cognitive robotics
Learning in autonomous robotics	Applied to sensing and actuation Applied to control (reinforcement learning, evolutionary robotics, neural control)

Planning				
Methodologies / tests	Competencies / Results	Teaching hours (in-person & virtual)	Student?s personal work hours	Total hours
Supervised projects	B2 B7 C3 C7 C8	7.5	30	37.5
Guest lecture / keynote speech	A18 A19 B1 B6 C8	9	0	9
Seminar	B6 C3 C7	3	6	9
Document analysis	A18 A19 B1 B3 B9 C5	1.5	3	4.5
Objective test	A18 B1 B6 B9	2	12	14
Personalized attention		1	0	1
(*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.				

Methodologies	
Methodologies	Description

Supervised projects	Practices in which some of the techniques seen in the theoretical classes on robot simulation environments and the robotic platforms selected by the teachers of the assignment will be implemented. These works will be carried out by the students autonomously and their progress will be tutored by the teachers.
Guest lecture / keynote speech	Oral presentation by the teachers of the theoretical subject. This methodology can be hybridized with a collaborative learning methodology.
Seminar	Practical programming classes in which the basic tools used in the tutored work will be explained: simulator and programming libraries.
Document analysis	Methodological technique that involves the use of audiovisual and/or bibliographic documents relevant to the subject matter with activities specifically designed for their analysis. In this case, it will be used in a context of "inverted class" in which the theoretical concepts will be reviewed by the students independently prior to the lecture session, in which there will be an activity to evaluate their understanding.
Objective test	Individual written exam of the theoretical part of the course.

Personalized attention	
Methodologies	**Description**
Document analysis Seminar Supervised projects	Supervised projects the use of personalised attention is recommended in these activities to resolve conceptual or procedural doubts that may arise during the resolution of the practical problems. In addition, the personalised attention will also focus on the explanation, by the student, of the proposed solution. Seminar: the teacher will help students to understand the practical tools. Analysis of documentary sources: students will be able to consult the lecturers on reference materials prior to the lecture sessions. Part-time students will receive personalised attention in all of the above methodologies through online tutoring.

Assessment			
Methodologies	**Competencies / Results**	**Description**	**Qualification**
Objective test	A18 B1 B6 B9	Final test of the subject which will consist of an individual written examination of the theory part. General evaluation criteria: * Correct answers and appropriate solutions to the test questions.	30
Document analysis	A18 A19 B1 B3 B9 C5	Part of the lectures will be used to evaluate the understanding of the documentary sources, which will be provided by the teaching staff prior to the class for consultation and understanding. These evaluations will be carried out by means of group work, small reports, questionnaires, or other methodologies that allow an objective assessment of the degree of analysis carried out.	20
Supervised projects	B2 B7 C3 C7 C8	Several practical tasks will be proposed throughout the course focused on solving problems using autonomous robots. These tasks will be developed autonomously by the student and will have to be defended afterwards. It is essential to obtain a passing grade in this methodology independently (minimum grade of 5 considering that it is assessed from 0 to 10) in order to pass the course.	50

Assessment comments

The evaluation of the subject will consist of two different parts: theory (50%) and practical work (50%). The theoretical part will be evaluated by means of an objective test and by means of the Document analysis carried out during the course. The practical part will be evaluated on the basis of the solution achieved by the students, which must be presented at the end of each practical (which may include a report). It will be necessary to pass the theory part and the practical part separately in order to pass the course.
Attendance to both theory and practical classes will be compulsory in order to pass the course, except in cases of justified absence. For those students who have an exemption, the value of the Document analysis methodology will be included in the Objective Test (50). In addition, they will not be obliged to attend the theory classes.
Second chance assessment: Students will have to make up each failed part (theory and/or practical). If one of the two parts was passed during the first opportunity, the student may choose to keep the corresponding mark and only recover the failed part.
The subject-specific competences as well as the general-basic competences have specific contents in the subject that are introduced both in the lectures and in the interactive classes. Subsequently, students will develop these competences in the classroom activities, in the theory exam and by carrying out practical work in which they will also work on the transversal competences, especially those related to the ability to use ICT tools (CT3), the understanding of entrepreneurial culture (CT5), the ability to work in a team (CT7) and the valuation of research and innovation (CT8). The specific competences will be assessed both in the practical work that the student carries out during the course and in the theory exam and in the assignments in the theory classes.
For cases of fraudulent performance of exercises or tests, the "Regulations for the evaluation of students' academic performance and revision of grades" will apply. In the specific case of the UDC, article 11, section 4 b) of the UDC Student Disciplinary Regulations applies:
b) Failure grade in the term in which the offence is committed and with respect to the subject in which it is committed: the student will be graded with a "fail" (numerical grade 0) in the corresponding term of the academic year, whether the offence is committed on the first or second occasion. To this end, the student's grade will be modified at the first opportunity, if necessary.

Sources of information	
Basic	- Nikolaus Correll (2020). Introduction to Autonomous Robots. Magellan Scientific - Robin R. Murphy (2019). Introduction to AI Robotics. MIT Press - Maja Mataric (2007). The Robotics Primer. MIT Press
Complementary	

Recommendations
Subjects that it is recommended to have taken before
Subjects that are recommended to be taken simultaneously
Machine Learning I /614544012
Subjects that continue the syllabus
Intelligent Robotics II/614544020
Other comments
-According to the different regulations applicable to university teaching, the gender perspective must be incorporated into this subject.-Work will be done to identify and modify sexist prejudices and attitudes and influence the environment to modify them and promote values of respect and equality.-Situations of gender discrimination should be detected and actions and measures should be proposed to correct them.In order to help achieve a sustainable environment and fulfil the objective of the Green Campus Action Plan, the delivery of the documentary work carried out in this area:- Virtual format or digital support will be requested.- They'll be done on the Virtual Campus without printing them.In case they?re done in paper:- Don't use plastics.- Use double-sided printing.- Use recycled paper.- Avoid printing drafts.