UNIVERSIDADE DA CORUÑA

Teaching Guide			
Identifying Data			2024/25
Subject (*)	Autonomous Vehicles: Introductory	Code	730556015
Study programme	Máster Universitario en Informática Industrial e Robótica (Plan 2024)		

Descriptors				
Cycle	Period	Year	Type	Credits
Official Master's Degree	2nd four-month period	First	Optional	3

Language	SpanishGalician		
Teaching method	Face-to-face		
Prerequisites			
Department	Ciencias da Computación e Tecnoloxías da InformaciónEnxeñaría IndustrialEnxeñaría Naval e Industrial		
Coordinador	Bellas Bouza, Francisco Javier	E-mail	francisco.bellas@udc.es
Lecturers	Bellas Bouza, Francisco Javier Prieto Garcia, Abraham Quintián Pardo, Héctor	E-mail	francisco.bellas@udc.es abraham.prieto@udc.es hector.quintian@udc.es
Web			
General description	The aim of the course is to provide a global vision of the problems to be dealt with and the existing solutions in the operation of mobile robots in industry, focusing on their autonomous operation. The course has a clearly practical focus, and the theoretical concepts will be worked on in a practical way through the programming of rolling robots, both real and simulated.		

Study programme competences / results	
Code	Study programme competences / results
A14	COMP14 - Capacidad para diseñar, simular y/o implementar soluciones tecnológicas que impliquen el uso de robots y/o sistemas de informática industrial en un entorno, contemplando aspectos éticos y legales.
A17	COMP17 - Capacidad para alcanzar la optimización, eficiencia y sostenibilidad en el desarrollo de sistemas robóticos y/o industriales y/o metaheurísticos.
A23	CON05 - Adquirir un entendimiento profundo de los principios básicos de la robótica y las tecnologías innovadoras en automatización.
A26	CON08 - Identificar las estructuras mecánicas básicas y avanzadas con las que se construyen las distintas morfologías robóticas, así como las claves y parámetros de su comportamiento, y los modelos cinemáticos y dinámicos de robots.
A52	OPT-COMP9 - Comparar as principais problemáticas e solucións existentes na planificación de traxectorias, a navegación autónoma, a localización e creación de mapas
A68	OPT-CON9 - Identificar as particularidades dos robots móbiles no contexto da robótica industrial, e en concreto, dos robots móbiles autónomos.
A86	OPT-HAB9 - Distinguir os principios físicos dos sensores utilizados na navegación autónoma de robots, e os seus contextos de aplicación.

Learning outcomes			
Learning outcomes	Study programme competences / results		
Knowledge of the particularities of mobile robots in the context of industrial robotics, and in particular of autonomous mobile robots.	AR14		
Knowledge of the physical principles of sensors used in autonomous robot navigation, and their application contexts.	AR17 AR23 AR26		
Knowledge of the problems and the main existing solutions in localisation and mapping.	AR52		
	AR68		
	AR86		

Contents	
Topic	**Sub-topic**
Introduction to mobile robotics	Kinematics of mobile robots Locomotion: - Motors - Degrees of freedom - Legs - Wheels - Other effectors
Perception in mobile robotics	- Types of sensors - Sensors in mobile robotics -- Contact -- Distance -- Computer vision -- IMU -- GPS - Control architectures -- Deliberative -- Reactive -- Hybrid -- Communications
Movement control	- Position control system
Localization and mapping	- Navigation: -- Topological -- Metric - Simultaneous localisation and mapping -- Localisation (odometry, beacons) -- Visual SLAM
Trajectory planning and navigation	- Graph search - Wavefront-based planning

Planning				
Methodologies / tests	**Competencies / Results**	**Teaching hours (in-person & virtual)**	**Student?s personal work hours**	**Total hours**
Guest lecture / keynote speech	A23 A52 A68 A86	10.5	4.5	15
ICT practicals	A14 A17	10.5	4.5	15
Oral presentation	A23 A52 A68 A86	3	9	12
Supervised projects	A14 A17 A26 A86	0	30	30
Personalized attention		3	0	3
(*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.				

Methodologies	
Methodologies	**Description**
Guest lecture / keynote speech	Oral presentation of the theoretical syllabus by the teachers of the course.
ICT practicals	Face-to-face sessions with the computer in which teachers will explain the use and programming of the mobile robotics techniques seen in theory, so that students acquire sufficient skills to use them autonomously. Real and/or simulated robots will be used.

Oral presentation	Theory paper(s) on a topic proposed by the teachers of the course, which must be presented in front of classmates and also handed in in writing.
Supervised projects	Practical tasks of programming in which some of the techniques seen in the theoretical classes will be implemented on simulation environments of robots or real robots. These tasks will be carried out autonomously by the students and their progress will be tutored by the teachers.

Personalized attention	
Methodologies	**Description**
Supervised projects ICT practicals	The aim is to guide the student in those questions related to the subject taught and that are of special difficulty for its understanding or realization. The channels of information and contact will be e-mail, Campus Virtual and Teams. The individualized meetings that are developed during the hours of tutoring established by the teacher. During the practical work through ICT, the student will be able to consult the teacher about all the doubts that may arise regarding the programming of the robots. Supervised projects: we recommend the use of personalised attention in these activities to resolve conceptual or procedural doubts that may arise during the resolution of practical problems. In addition, personalised attention will also focus on the student's explanation of the proposed solution. Oral presentation: students will have to go to the teachers to resolve any doubts they may have about the preparation of the work to be presented, both in terms of the content and the presentation itself.

Assessment			
Methodologies	**Competencies / Results**	**Description**	**Qualification**
Supervised projects	A14 A17 A26 A86	Several practical works will be proposed throughout the course focused on the resolution of problems using autonomous vehicles. These works will be developed by the student outside of class and will have to be defended afterwards.	60
Oral presentation	A23 A52 A68 A86	The oral presentation of the theoretical work/works, the written version of the same and the active participation in the presentations of the classmates have an important weight in the final grade of the course.	20
Guest lecture / keynote speech	A23 A52 A68 A86	During the lectures, in person activities will be carried out to reinforce the comprehension of the theoretical aspects.	10
ICT practicals	A14 A17	Session in the ICT classrooms where students are trained on the tools to be used in the practical part of the subject, such as simulators, real robots or programming libraries.	10

Assessment comments

First opportunity:
Depending on the complexity of the tools to be used, the score of the ICT practices can be accumulated in the part of Supervised Projects. In order to obtain a pass in the first opportunity, a minimum score of 50 must be exceeded by adding all the previous methodologies, being necessary to obtain a minimum of 35 in the sum of the Supervised Projects and the ICT Practices, and 15 in the sum of the Oral Presentation and the Master Session.
Second opportunity:
If the student does not pass the subject on the first opportunity, he/she must repeat the activities that are necessary from the method(s) that were not passed in the second call. For example, if a student passed the Oral Presentation + keynote part, but failed the Supervised Work, he/she must repeat the practical work necessary to pass the course, normally those that were not individually passed.
In the second opportunity, the minimum grade criteria established in the first call are maintained.
Early opportunity
For this opportunity, the same criteria are maintained as for the first, with the student having to specify delivery deadlines with the subject teachers.
Students with part-time registration or academic exemption
They may accumulate 10% of the grade corresponding to the keynote in the oral presentation in both sessions. This modification must be requested from the professors of the subject at the beginning of the semester. Likewise, if they cannot make the oral presentation with the rest of the students, they must arrange an alternative date with the professors in all sessions.
All regulatory aspects related to ?academic exemption?, ?dedication to study?, ?permanence? and ?academic fraud? will be governed in accordance with the current academic regulations of the UDC (https://www.udc.es/es/normativa/academica/)

Sources of information	
Basic	- Kelly, Alonzo (2013). Mobile robotics: mathematics, models and methods. Cambridge University Press - Nehmzow, Ulrich (2003). Mobile robotics a practical introduction. Springer - ? Siegwart, Roland (2004). Introduction to autonomous mobile robots. MIT Press
Complementary	- Joseph, Lentin (2015). Learning robotics using Python : design, simulate, program, and prototype an interactive autonomous mobile robot from scratch with the help of Python, ROS, and Open-CV. Packt Publishing - Robin R. Murphy (2000). Introduction to AI Robotics. A Bradford Book - Lynch, Kevin (2017). Modern robotics : mechanics, planning, and control. Cambridge University Press

Recommendations
Subjects that it is recommended to have taken before
Introduction to Python for Engineers/730556010 Smart Robotics and Autonomous Systems/770538005
Subjects that are recommended to be taken simultaneously
Machine Learning I/770538016 Artificial Vision: Introductory/730556019
Subjects that continue the syllabus
Autonomous Vehicles: Advanced/730556016
Other comments
1.- The delivery of the documentary works that are carried out in this subject:? 1.1. It will be requested in virtual format and/or computer support.? 1.2. It will be done through Moodle, in digital format without the need to print them? 1.3. If done on paper:- No plastic will be used.- Double-sided printing will be done.- Recycled paper will be used.- Printing drafts will be avoided.2.- Sustainable use of resources must be made and negative impacts on the natural environment must be prevented.3.- The importance of ethical principles related to the values ??of sustainability in personal and professional behavior must be taken into account.4.- According to the different regulations applicable to university teaching, the gender perspective must be incorporated in this matter (non-sexist language will be used, bibliography by authors of both sexes will be used, the intervention of male and female students in class will be encouraged...).5.- Work will be done to identify and modify sexist prejudices and attitudes, and the environment will be influenced to modify them and promote values ??of respect and equality.6. Situations of discrimination based on gender must be detected and actions and measures will be proposed to correct them.7. The full integration of students who, for physical, sensory, psychological or sociocultural reasons, experience difficulties in having suitable, equal and beneficial access to university life will be facilitated.

(*)The teaching guide is the document in which the URV publishes the information about all its courses. It is a public document and cannot be modified. Only in exceptional cases can it be revised by the competent agent or duly revised so that it is in line with current legislation.