Guía Docente				
Datos Identificativos				2024/25
Asignatura (*)	Vehículos Mariños Autónomos		Código	730542017
Titulación				
Descriptores				
Ciclo	Período	Curso	Tipo	Créditos
Mestrado Oficial	2º cuadrimestre	Primeiro	Optativa	6
Idioma	Inglés			
Modalidade docente	Presencial			
Prerrequisitos				
Departamento	Ciencias da Computación e Tecnoloxías da InformaciónMatemáticas			
Coordinación	Bellas Bouza, Francisco Javier	Correo electrónico	francisco.bellas@udc.es	
Profesorado	Bellas Bouza, Francisco Javier Orjales Saavedra, Félix	Correo electrónico	francisco.bellas@udc.es felix.orjales@udc.es	
Web	http://www.master-seas40.unina.it			
Descrición xeral	The main objective of the course is to provide the students with an updated vision of autonomous marine vehicles, both surface and underwater systems. The topics are mainly focused on providing students with the basics of intelligent control systems in marine environments. In addition, it will also provide a technical and regulatory approach to the field of robotics within this scope. In order to obtain these goals, and apart from the theoretical basis, students will work with simulated and real marine vehicles, thus developing the skills needed to tackle the implementation of real autonomous marine robots.			

Competencias / Resultados do título	
Código	Competencias / Resultados do título

Resultados da aprendizaxe			
Resultados de aprendizaxe	Competencias / Resultados do título		
Capacity for applying mathematical and ICT methods and tools to define, design, operate and maintain advanced marine robotic systems and for understanding and developing the needed algorithms and methods.		BM1 BM2 BM3 BM4 BM5 BM6 BM7 BM10 BM12	CM2 CM3 CM4 CM6 CM7
Understanding the difference between autonomous and non-autonomous operation in robotics, and how it fits into the Artificial Intelligence field	AM4	BM3 BM5 BM7 BM12	CM4
Acquiring the knowledge about sensors and actuators relevant in marine vehicles to provide them with autonomous capabilities	AM4	BM1 BM3 BM5 BM7 BM12	CM4 CM6 CM7

Understanding the fundamentals of autonomous robotic control, and how classical techniques are very important to achieve a proper response. Being able to apply these concepts in navigation tasks	AM4	BM1 BM2 BM3 BM5 BM7 BM12	CM3 CM4 CM6 CM7
Capacity for using a marine vehicle simulator and programming it, including all the previous knowledge about sensors, actuators and autonomous/classical control. In addition, students must learn how to transfer the simulated control to the real platform	AM4	BM2 BM3 BM5 BM6 BM7 BM8 BM10 BM12	CM3 CM6 CM7

Contidos	
Temas	**Subtemas**
Topic 1. Introduction to autonomous vehicles	- Artificial Intelligence - Autonomous vehicles - Autonomous marine vehicles - Regulatory issues
Topic 2. Sensors and actuators in marine vehicles	- Sensors: -- Sound based (Sonar, DVL, range finders...) -- Vision and laser based (Cameras, LIDAR...) -- Inertial Measurement Units (IMU) -- GNSS and alternative positioning systems - Actuators: -- Thrusters and alternative propulsion methods -- Arms and grippers
Topic 3. Autonomous control	- Open loop control - Closed loop control - PID - Intelligent architectures -- Reactive -- Deliberative -- Hybrid
Topic 4. Autonomous navigation	- Localization - Mapping - Path planning
Topic 5. Programming underwater vehicles	- Gazebo simulation model - Programming framework - Real underwater vehicle

Planificación				
Metodoloxías / probas	**Competencias / Resultados**	**Horas lectivas (presenciais e virtuais)**	**Horas traballo autónomo**	**Horas totais**
Sesión maxistral	B2 B4 B6 C4 C6	15	3	18
Análise de fontes documentais	A4 B2 B4 B5 B13 C2 C7	3	9	12

Seminario	B3 B6 B8 C3 C6	9	9	18
Traballos tutelados	A4 B3 B4 B5 B6 B7 B8 B9 B11 B13 C2 C3 C7	18	72	90
Proba mixta	A4 B4 B5 B6 B11 B13 C2	2	8	10
Atención personalizada		2	0	2
***Os datos que aparecen na táboa de planificación son de carácter orientativo, considerando a heteroxeneidade do alumnado**				

Metodoloxías	
Metodoloxías	**Descrición**
Sesión maxistral	Masterclass where teachers explain the theoretical concepts of the topics, and students can ask questions.
Análise de fontes documentais	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 "flipped classroom" in which the theoretical concepts will be reviewed by the students independently prior to the lecture session, in which an activity will be carried out to assess their understanding.
Seminario	Workshop carried out at the informatics lab to train students in the tools required to solve de challenge: Python libraries, BlueRov programming, etc
Traballos tutelados	Autonomous work where students must solve some challenge involving programming an autonomous marine vehicle to solve a task. There can be one of incremental complexity or more than one with independent objectives. In this methodology, students will be organised in groups, so they will have to collaborate to achieve the goal.
Proba mixta	Written or oral examination where students will show their understanding of the theoretical concepts of the subject.

Atención personalizada	
Metodoloxías	**Descrición**
Traballos tutelados Seminario Análise de fontes documentais	In the practical workshops (seminars), the teacher will supervise the students' progress and help them with all the issues that could arise. In the supervised projects, students will have the option of asking their questions and doubts to the teachers while developing their project autonomously. Document analysis: students will be able to consult lecturers on reference materials prior to the lectures.

Avaliación			
Metodoloxías	**Competencias / Resultados**	**Descrición**	**Cualificación**
Proba mixta	A4 B4 B5 B6 B11 B13 C2	Students will have to show their knowledge and understanding of the theoretical concepts of the subject by means of a written or oral activity	25
Traballos tutelados	A4 B3 B4 B5 B6 B7 B8 B9 B11 B13 C2 C3 C7	One or more incremental projects will be proposed throughout the course focused on solving realistic problems with autonomous marine problems using real and simulated robots. These tasks will be developed autonomously by the student outside the classroom and must be defended in front of the teachers.	70
Análise de fontes documentais	A4 B2 B4 B5 B13 C2 C7	Part of the lectures will be used to evaluate the understanding of the documentary sources, which will be provided by the teachers 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.	5

Observacións avaliación

In order to obtain a pass in this subject, a minimum mark of 50 must be obtained in all the above methodologies, with a minimum of 35 in the Tutored Work and 15 in the sum of the Subjective Test and Document Analysis. If the student does not pass the subject in the ordinary exam, he/she will have to repeat the necessary activities of the methodology/s that were not passed in the extraordinary exam.
General EMJMD Sustainable Ship and Shipping SEAS 4.0 evaluation rules:
- Students will have only two oportunities to pass a course. If failing to do so, they may be forced to leave the degree.
- No part time or lecture attendance exemption are allowed in this degree.
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/)

Fontes de información	
Bibliografía básica	- Thor I. Fossen (2011). Handbook of Marine Craft Hydrodynamics and Motion Control. John Wiley & Sons - Geoff Roberts and Robert Sutton (2006). Advances in unmanned marine vehicles. Institution of Engineering and Technology - Robin R. Murphy (2000). Introduction to AI Robotics. A Bradford Book - Dronekit (2015). https://dronekit-python.readthedocs.io/en/latest/.
Bibliografía complementaria	- 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

Recomendacións
Materias que se recomenda ter cursado previamente
Marco Regulamentario para a Industria Marítima 4.0/730542001 Robótica e Robótica Submarina/730542007
Materias que se recomenda cursar simultaneamente
Internet das Cousas Aplicado á Industria (IIoT)/730542015 Tecnoloxías Facilitadoras da Industria 4.0/730542010
Materias que continúan o temario
Observacións
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.