UNIVERSIDADE DA CORUÑA

Guía Docente					
Datos Identificativos				**2022/23**	
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	
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	Orjales Saavedra, Félix			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 do título	
Código	**Competencias do título**

Resultados da aprendizaxe		
Resultados de aprendizaxe	**Competencias 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	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**	**Horas presenciais**	**Horas non presenciais / traballo autónomo**	**Horas totais**
Prácticas a través de TIC	B3 B6 B8 C3 C6	18	18	36
Sesión maxistral	B2 B4 B6 C4 C6	18	9	27

Traballos tutelados	A4 B3 B4 B5 B6 B7 B8 B9 B11 B13 C2 C3 C7	0	55	55
Saídas de campo	A4 B3 B7 B9 B11 B13 C4 C7	4	8	12
Proba mixta	A4 B4 B5 B6 B11 B13 C2	2	16	18
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**
Prácticas a través de TIC	Practical classes carried out in the ICT lab, with the objective of learning how to program an autonomous marine vehicle (real or simulated) to develop a simple mission. In these classes, the teacher will help students to properly understand the topics
Sesión maxistral	Masterclass where teachers explain the theoretical concepts of the topics, and students can ask questions.
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.
Saídas de campo	A field trip will be made to the UDC ship model basin to analyse the real conditions of the environment where the ROV operates
Proba mixta	Written or oral examination where students will show their understanding of the theoretical concepts of the subject.

Atención personalizada	
Metodoloxías	**Descrición**
Prácticas a través de TIC Traballos tutelados	In the practical workshops, 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.

Avaliación			
Metodoloxías	**Competencias**	**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	30
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 or simulated robots. These tasks will be developed autonomously by the student outside the classroom and must be defended in front of the teachers.	60
Saídas de campo	A4 B3 B7 B9 B11 B13 C4 C7	The correct preparation, execution and understanding of the field trip will be assessed by the teachers of the subject. Students must prepare a report which will be evaluated.	10

Observacións avaliación
In order to pass this subject, a minimum score of 50 must be obtained by adding all the above methodologies, there being no minimum in any of them. 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.

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
To help in achieving a sustainable environment and to get the objective of number 5 action of the "Ferrol Green Campus Action Plan" (Healthy and environmentaly and socially sustainable research and teaching):The assignments to be done in this course:- Will be required in digital format.- Will be delivered using Moodle, with no need to print them.In case it is necessary to print them:- Plastics won´t be used.- Two side printing will be used.- Recycled paper will be used.- Printing drafts will be avoided.A sustainable use of the resources should be done, together with the prevention of negative impacts on the environment.

(*)A Guía docente é o documento onde se visualiza a proposta académica da UDC. Este documento é público e non se pode modificar, salvo casos excepcionais baixo a revisión do órgano competente dacordo coa normativa vixente que establece o proceso de elaboración de guías