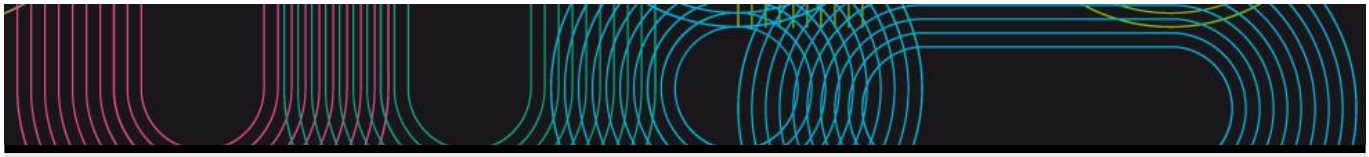

(*)Escola de Enxeñaría de Telecomunicación

(*)Páxina web

(*)

www.teleco.uvigo.es

(*)Presentación

The School of Telecommunication Engineering (EET) is a higher education school of the University of Vigo that offers Bachelor's degrees, Master's degrees and Doctoral programs in the fields of Telecommunications Engineering.

Bachelor's Degree in Telecommunication Technologies Engineering (EUR-ACE®).

The mail goal of the Bachelor's Degree in Telecommunication Technologies Engineering is to form professionals at the forefront of technological knowledge and professional competences in telecommunication engineering. This Bachelor has been recognized with the best quality seals, like the EUR-ACE's. **It has a bilingual option: up to 80% of the degree credits can be taken in English**.

http://teleco.uvigo.es/images/stories/documentos/gett/degree_telecom.pdf

www: http://teleco.uvigo.es/index.php/es/estudios/gett

Master in Telecommunication Engineering

The Master in Telecommunication Engineering is a Master's degree that qualifies to exercise the profession of Telecommunication Engineer, in virtue of the established in the Order CIN/355/2009 of 9 of February.

http://teleco.uvigo.es/images/stories/documentos/met/master_telecom_rev.pdf

www: http://teleco.uvigo.es/index.php/es/estudios/mit

Interuniversity Masters

The current academic offer includes interuniversity master's degrees that are closely related to the business sector:

Master in Cybersecurity: www: https://www.munics.es/

Master in Industrial Mathematics: www: http://m2i.es

International Master in Computer Vision: www: https://www.imcv.eu/

(*)Equipo directivo

MANAGEMENT TEAM

Directora: Rebeca Pilar Díaz Redondo (teleco.direccion@uvigo.gal)

Secretaría e Subdirección de Novas Titulacións: Pedro Rodríguez Hernández

(teleco.subdir.secretaria@uvigo.gal;teleco.subdir.novastitulacions@uvigo.gal)

Subdirección de Organización Académica: Pedro Comesaña Alfaro (teleco.subdir.academica@uvigo.gal)

Subdirección de Relaciones Internacionais e Subdirección de Infraestructuras: María Verónica Santalla del

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Subdirección Difusión e Captación: Laura Docio Fernández (teleco.subdir.captacion@uvigo.gal)

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BACHELOR□SDEGREE IN TELECOMMUNICATION TECHNOLOGIES ENGINEERING

Generalcoordinator: Lucía Costas Pérez (teleco.grao@uvigo.gal)

https://teleco.uvigo.es/es/documentos/acordos-es/comisions-academicas-es/miembros-de-la-comision-academica-del-gett/

MASTER IN TELECOMMUNICATION ENGINEERING

Generalcoordinator: Manuel García Sánchez (teleco.master@uvigo.gal)

https://teleco.uvigo.es/es/documentos/acordos-es/comisions-academicas-es/miembros-de-la-comision-academica-del-met/

MASTER INCYBERSECURITY

General coordinator:Ana Fernández Vilas (teleco.munics@uvigo.gal)

https://teleco.uvigo.es/es/documentos/acordos-es/comisions-academicas-es/miembros-de-la-comision-academica-del-munics/

MASTER ININDUSTRIAL MATHEMATICS

Generalcoordinator: Elena Vázquez Cendón (USC)

UVigo coordinator:José Durany Castrillo (durany@dma.uvigo.es)

http://www.m2i.es/?seccion=coordinacion

INTERNATIONALMASTER IN COMPUTER VISION

General coordinator: Xose Manuel Pardo López (USC)

UVigo coordinator:José Luis Alba Castro (jalba@gts.uvigo.es)

https://www.imcv.eu/legal-notice/

MASTER'S DEGREE IN QUANTUM INFORMATION SCIENCE AND TECHNOLOGIES (MQIST)

General coordinator: Javier Mas (USC)

Coordinador UVIGO: Manuel Fernández Veiga(teleco.mqist@uvigo.es)

https://quantummastergalicia.es/info

(*)Máster Universitario en Internet das Cousas- IoT

Subjects			
Year 1st			
Code	Name	Quadmester	Total Cr.
V05M200V01101		1st	4.5
V05M200V01102		1st	4.5
V05M200V01103		1st	3
V05M200V01104		1st	4.5
V05M200V01105		1st	3
V05M200V01106		1st	3

V05M200V01107		1st	4.5
V05M200V01108		1st	3
V05M200V01201		2nd	4.5
V05M200V01202		2nd	4.5
V05M200V01203		2nd	3
V05M200V01204		2nd	3
V05M200V01205		2nd	3
V05M200V01206		2nd	3
V05M200V01207		2nd	3
V05M200V01208		2nd	6
V05M200V01209		2nd	3
V05M200V01210		2nd	3
V05M200V01211		2nd	3
V05M200V01212		2nd	3
V05M200V01213		2nd	3
V05M200V01214		2nd	3
V05M200V01215		2nd	3
V05M200V01216		2nd	3
V05M200V01217		2nd	3
V05M200V01218		2nd	3
V05M200V01219		2nd	3
V05M200V01220		2nd	3
V05M200V01221		2nd	3
V05M200V01222		2nd	3
V05M200V01223		2nd	3
V05M200V01224		2nd	3

IDENTIFYING DATA				
(*)Dispositivos IoT				
Subject	(*)Dispositivos IoT			
Code	V05M200V01101			
Study programme	(*)Máster Universitario en Internet das Cousas- IoT			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	4.5	Mandatory	1st	1st
Teaching language	Spanish Galician			
Department				
Coordinator	Valdés Peña, María Dolores			
Lecturers	Arias Acuña, Alberto Marcos Quintáns Graña, Camilo Rubiños López, José Óscar Valdés Peña, María Dolores			
E-mail	mvaldes@uvigo.es			
Web	http://moovi.uvigo.gal/course			
General description	In this subject, the basic elements that make up IoT systems are introduced. Special emphasis is placed on three functional blocks: sensors and actuators as interface devices between the system and its environment, power methods for low-power systems, and wireless communication resources and fundamentals. In the first block, the study focuses on the conditioning of the signals to be measured and the connection mechanisms with digital processors. Within the power systems, technologies for collecting energy from the environment (energy harvesting) and energy storage elements are prioritized. Finally, within wireless communication systems, the fundamentals of communication between the different IoT devices are analyzed, which will allow the analysis and design of systems that meet the necessary specifications for the proper functioning of the system. It is a subject with a marked practical nature.			

Training and Learning Results	
Code	
B4	CNC4: Determine the sensor and actuator devices needed for IoT applications.
C4	HBL4: Develop low-power IoT systems.
C5	HBL5: Develop embedded systems for IoT applications.
C12	HBL12: Apply the acquired knowledge and solve problems in new or unfamiliar environments within broader, multidisciplinary contexts, being able to integrate knowledge.
D1	CMP1: Design IoT devices by selecting the most appropriate sensors/actuators for each use.

Expected results from this subject	
Expected results from this subject	Training and Learning Results
Know the sensor and actuator devices used in IoT applications	B4 C12
Design signal conditioning circuits for sensors and actuators	B4 C5 C12 D1
Know and design connection interfaces for digital and analog sensors and actuators	B4 C5 C12 D1
Know the different energy sources to power IoT systems	C4 C12
Design very low power energy storage and conversion systems	C4 C5 C12 D1
Know energy harvesting systems	C4
Know the fundamentals of communication between wireless devices in IoT applications (electromagnetic spectrum, antennas, power considerations, propagation)	B4 C4 C5 C12
Control of exposure of people to electromagnetic fields	C12

Contents

Topic	
Sensors and actuators for IoT	- Sensors and actuators: types and use cases - Connections with microcontrollers: I2C, SPI - Signal conditioning circuits - Calibration
Power systems for IoT	- Energy sources - Energy storage - Very low power energy conversion - Energy harvesting systems
Fundamentals of wireless device communication in IoT	- Electromagnetic spectrum - Antennas - Power considerations. Link balance - Propagation of radio waves - Control of exposure of people to electromagnetic fields
Practical activities	- Assembly of a microcontroller connected to sensors/actuators using different communication protocols. - Digital and analog inputs/outputs. Signal conditioning. - Study of different energy harvesting sources and their energy conversion systems by assembly and simulation. - Simulation of antenna radiation and radio communication systems.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	22	36	58
Laboratory practical	12	24	36
Autonomous problem solving	0	8	8
Essay questions exam	2	0	2
Problem and/or exercise solving	0	8.5	8.5

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies

	Description
Lecturing	The teaching staff presents the theoretical content of the subject, encouraging critical discussion and student participation. As a prior task, the documentation for each session will be available on the subject's website and the student is expected to attend the class by reading it previously. In lecturing sessions, skills B4, C4, C5 and C12 are worked on.
Laboratory practical	In the laboratory sessions, the students apply the design methods described in the master classes. All sessions are guided and supervised by teachers. In the laboratory practices, skills B4, C4, C5, C12 and D1 are worked on.
Autonomous problem solving	The students solve exercises related to the subject autonomously. Using this methodology, skills B4, C4, C5, C12 and D1 are worked on.

Personalized assistance

Methodologies	Description
Lecturing	Students have the opportunity to resolve their doubts in personalized attention sessions. The appointment with the corresponding teacher must be requested and confirmed by email, preferably during the schedule published on the center's website. Links to faculty contact details are available on the subject website.
Laboratory practical	Students have the opportunity to resolve their doubts in personalized attention sessions. The appointment with the corresponding teacher must be requested and confirmed by email, preferably during the schedule published on the center's website. Links to faculty contact details are available on the subject website.
Autonomous problem solving	Students have the opportunity to resolve their doubts in personalized attention sessions. The appointment with the corresponding teacher must be requested and confirmed by email, preferably during the schedule published on the center's website. Links to faculty contact details are available on the subject website.

Assessment

	Description	Qualification	Training and Learning Results		
Laboratory practical	These tests will be carried out during the laboratory practice sessions. The grade will be based on the completion of the tasks indicated in the practice scripts and on the reports that must be delivered after each session.	35	B4	C4 C5 C12	D1
Autonomous problem solving	Students will solve a set of problems and/or exercises autonomously, which will be indicated in master class sessions.	10	B4	C12	
Essay questions exam	Essay questions exam will be carried out that evaluate the contents taught in the theoretical and/or practical classes.	35	B4	C4 C5 C12	D1
Problem and/or exercise solving	Tests of problems and/or exercises that evaluate the contents taught in the theoretical and/or practical classes will be carried out.	20		C4 C5 C12	D1

Other comments on the Evaluation

The subject can be passed with the maximum grade through continuous assessment (CA) or global assessment (GA). Both evaluation methods are exclusive. The student who attends more than 2 laboratory sessions is considered to have opted for continuous assessment. However, those who wish to waive continuous assessment may do so within a maximum of one month before the end of the semester.

1. Continuous assessment (CA)

Students who opt for the CA modality will have two evaluation opportunities, the ordinary call at the end of the two-month period and the extraordinary one at the end of the course.

1.1 Ordinary call:

The ordinary call consists of a set of assessments that will be carried out throughout the two-month period. The dates of all the tests will be published in a shared calendar and will be available at the beginning of the course. The weight and content of the assesssments is as follows:

- *Essay questions exam* and *Problem and/or exercise solving* (NExam):

- It covers all of the contents taught in the theoretical classes and/or practices..
- At least two tests of this type will be carried out during the bimester teaching period, ensuring that none of them exceeds 40% of the final grade for the subject.
- Students pass this part if they obtain a NExam grade greater than or equal to 4 out of 10.

- *Autonomous problem solving* (NExerc):

- It consists of a set of problems and/or exercises that are indicated in the lecturing sessions and that the students must submit on certain previously stipulated dates.
- These activities will be carried out during autonomous work hours.

- *Laboratory practices* (NPrac):

- The students must simulate and/or implement the systems described in the practice scripts and deliver a results report corresponding to each practice. The grade for each practice depends on these results.
- Practices can be done individually or in groups of 2 or more students. In the latter case, the grade may be different for each member of the group who attends the practice.
- The practices are mandatory. Students must attend at least 80% of them.

Continuous assessment final grade (Final_CA):

The final grade of the ordinary CA is obtained as follows:

Final_CA = (NExam*0.55 + NExerc*0.1 + NPrac*0.35) if NExam is greater than or equal to 4 and Final_CA is greater than or equal to 5;

Final_CA = min[(NExam*0.55 + NExerc*0.1 + NPrac*0.35), 4.9] in any other case.

1.2 Extraordinary call:

Student who do not pass one or more assessments of the ordinary call can recover the following parts in the extraordinary call:

- They can take a theoretical exam and the grade obtained replaces the previous one (NExam).
- They can complete the practical activities and the grade obtained replaces the previous one (NPrac).

The final grade of the extraordinary call is obtained in the same way as the ordinary one.

2. Global assessment (GA)

As with the continuous assessment, students who opt for global assessment will have two opportunities, ordinary and extraordinary calls. In both cases it will consist of the following parts:

- An exam in which all the theoretical contents of the subject are evaluated. It consists of several problems and/or development questions. To pass the subject it is necessary to obtain a 4 out of 10. This exam (NExam) represents 60% of the final grade.
- A practical exam covering the same aims of the labortory practices developed during the course. The weight of this evaluation (NPrac) represents 40% of the final grade.

Global assessment final grade (Final_GA):

The final grade of the ordinary CA is obtained as follows:

Final_GA = (NExam*0.6 + NPrac*0.4) if NExam is greater than or equal to 4 and Final_GA is greater than or equal to 5;

Final_GA = min[(NExam*0.6 + NPrac*0.4), 4.9] in any other case.

3. Other comments:

- Students may write their reports, papers, exams or presentations in Spanish, Galician or English.
- Plagiarism is regarded as serious dishonest behavior. In the case that plagiarism is detected in any of the reports/tasks/exams done/taken, the final grade will be FAIL (0), and the incident will be reported to the corresponding academic authorities for prosecution.

Sources of information

Basic Bibliography

Ziemann, V., **A Hands-On Course in Sensors Using the Arduino and Raspberry Pi**, 9781032376196, 2ª, CRC Press, 2023

Pizarro Pelaez, J., **Internet de las cosas IOT con ESP**, 9788428344968, Editorial Paraninfo, 2020

Pérez García, M. A., et. al., **Instrumentación electrónica**, 8497321669, Thomson, 2004

Buyya, R., Dastjerdi, A. V., **Internet of Things: Principles and paradigms**, 978-0-12-805395-9, Elsevier, 2016

Spies, P., Pollak, M., Mateu, L., **Handbook of Energy Harvesting Power Supplies and Applications**, 9789814241861, Jenny Stanford Publishing, 2015

Arias Acuña, M., Rubiños López, Ó., **Radiocomunicación**, 978-84-8408-603-1, Andavira Editorial, 2011

Hernando Rábanos, J.M., **Transmisión por radio**, 978-84-9961-106, 7ª, Editorial Universitaria Ramón Areces, 2013

Complementary Bibliography

Fremantle, P., **A reference architecture for the internet of things**, 2014

Hernando Rábanos, J.M., Mendo Tomás, L., Riera Salís, J.M., **Comunicaciones móviles**, 978-84-9961-208-9, 3ª, Editorial Universitaria Ramón Areces, 2015

ITU-R Recomendations (https://www.itu.int/pub/R-REC),

Recommendations

IDENTIFYING DATA				
(*)Novas arquitecturas e paradigmas IoT				
Subject	(*)Novas arquitecturas e paradigmas IoT			
Code	V05M200V01102			
Study programme	(*)Máster Universitario en Internet das Cousas- IoT			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	4.5	Mandatory	1st	1st
Teaching language				
Department				
Coordinator	López Ardao, José Carlos			
Lecturers				
E-mail				
Web	http://guiadocente.udc.es/guia_docent/index.php?centre=614&ensenyament=614557&assignatura=614557005&any_academic=2024_25&idioma=cast&any_academic=2024_25			
General description	In this subject, the latest trends in IoT architectures will be studied, including decentralized/distributed architectures (e.g., based on distributed ledger technologies like blockchain) and those based on new paradigms such as Edge Computing, Fog Computing, or Mist Computing.			

Training and Learning Results
Code

Expected results from this subject	
Expected results from this subject	Training and Learning Results

Contents
Topic

Planning			
	Class hours	Hours outside the classroom	Total hours
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies
Description

Personalized assistance

Assessment		
Description	Qualification	Training and Learning Results

Other comments on the Evaluation

Sources of information
Basic Bibliography
Complementary Bibliography

Recommendations

IDENTIFYING DATA				
(*)Redes de comunicacións en IoT				
Subject	(*)Redes de comunicacións en IoT			
Code	V05M200V01103			
Study programme	(*)Máster Universitario en Internet das Cousas- IoT			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Mandatory	1st	1st
Teaching language	#EnglishFriendly Spanish Galician			
Department				
Coordinator	López Bravo, Cristina			
Lecturers	González Castaño, Francisco Javier López Bravo, Cristina			
E-mail	clbravo@det.uvigo.es			
Web	http://http://moovi.uvigo.gal			
General description	(*)A materia "Redes de comunicacións en IoT" examina as características dos distintos tipos de redes IoT e das tecnoloxías de rede para IoT. Materia do programa English Friendly. Os/as estudantes internacionais poderán solicitar ao profesorado: a) materias e referencias bibliográficas para o seguimiento da materia en inglés, b) atender as titorías en inglés, c) probas e avaliacións en inglés.			

Training and Learning Results	
Code	
B7	CNC7: Identify the characteristics of different types of networks and IoT network technologies.
C8	HBL8: Plan connectivity scenarios for IoT networks.
C12	HBL12: Apply the acquired knowledge and solve problems in new or unfamiliar environments within broader, multidisciplinary contexts, being able to integrate knowledge.
D3	CMP3: Build networks and define protocols to enable communication between IoT devices.

Expected results from this subject	Training and Learning Results
Know the main characteristic and requirements of an IoT communications network	B7
To know different network technologies applicable to IoT environments	B7
Capacity to choose the most suitable network technology for specific IoT scenarios	B7 C8 C12 D3
Capacity to design and deploy connectivity scenarios for IoT networks	B7 C8 C12 D3

Contents
Topic
Wireless personal and body area networks
Low-power WAN networks
Wireless Sensor Networks

Planning	Class hours	Hours outside the classroom	Total hours
Lecturing	16	28	44
Laboratory practical	8	8	16
Mentored work	0	8	8
Objective questions exam	2	0	2
Report of practices, practicum and external practices	0	4	4
Presentation	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	
	Description
Lecturing	Presentation by the faculty of the main theoretical contents related to communication networks in IoT. This methodology will contribute to the acquisition of competencies B7 and D3.
Laboratory practical	Conducting guided and supervised practical sessions by students, related to the content presented during the lectures. This methodology works on competencies B7, C8, C12, and D3.
Mentored work	Conducting a project related to various aspects of communication networks in IoT independently. The topic of each project will be agreed upon between students and faculty. This methodology works on competencies B7, C12, and D3.

Personalized assistance	
Methodologies	**Description**
Lecturing	The course instructors will provide personalized and individualized attention to students throughout the course, addressing their questions. Questions will be addressed either in person or remotely (during the lecture session itself or during designated office hours). Office hours will be scheduled with students by appointment (https://moovi.uvigo.gal/user/profile.php?id=11583).
Laboratory practical	The course instructors will provide personalized and individualized attention to students throughout the course, resolving their questions. Additionally, instructors will guide and assist students during the completion of assigned tasks in laboratory practices. Questions will be addressed either in person or remotely (during the lab sessions themselves or during designated office hours). Office hours will be scheduled with students by appointment (https://moovi.uvigo.gal/user/profile.php?id=11583).
Mentored work	The course instructors will provide personalized and individualized attention to students throughout the course, resolving their questions. Additionally, instructors will guide and assist students during the completion of tasks assigned in mentored work. Questions will be addressed either in person or remotely (during scheduled office hours). Office hours will be scheduled with students by appointment (https://moovi.uvigo.gal/user/profile.php?id=11583).

Assessment						
	Description	Qualification	Training and Learning Results			
Objective questions exam	There will be an individual assessment to evaluate the understanding of the content presented during the lecture sessions.	40	B7			
Report of practices, practicum and external practices	Students will individually complete questionnaires and/or reports on practices demonstrating their correct execution and understanding of the exercises.	40			C12	D3
Presentation	Students will carry out an individual project related to communication networks in IoT (such as studying other technologies not covered in class, performance analysis, etc.), which they will present in written form (through a report) and orally to the entire student body.	20	B7		C12	

Other comments on the Evaluation

Following the guidelines of the degree, each student will have two assessment opportunities (ordinary and extraordinary) to pass the subject. In turn, in the ordinary opportunity, they will have two evaluation procedures (continuous and global).

Ordinary exam

During the first month, students must declare if they opt for continuous or exam-only assessment. Students who select continuous assessment and submit the first task or lab report may not be listed as "Not Present".

Continuos assessment

The final grade (FG) of the course will be calculated as the weighted geometric mean of the grades obtained in the objective question test (QT), in the practical reports (PR), and for the completion of the mentored work (MW), according to the following formula:

FG = QT^0.4*PR^0.4*MW^0.2.

In order to pass the course, FG must be greater than or equal to 5. In addition, as a result of the application of the weighted geometric mean, it is not possible to have a zero in any of the parts in order to pass the course.

Global evaluation

Students that opt by the global assessment procedure, must submit an additional dossier with detailed information about the events and issues that arose during the execution of the different tasks, and especially during the lab.

The final grade (FG) of the course will be calculated as the weighted geometric mean of the grades obtained in the objective question test (QT), in the practical reports (PR), in the dossier of task performance (DT) and for the completion of the mentored work (MW), according to the following formula:

FG = PR^0.4*PR^0.3*DT^0.1*MW^0.2.

In order to pass the course, FG must be greater than or equal to 5. In addition, as a result of the application of the weighted geometric mean, it is not possible to have a zero in any of the parts in order to pass the course.

Extraordinary exam

The assessment system will be the same as the global assessment of the ordinary exam.

Students that have opted by the continuous assessment procedure, can decide to maintain the grades of the parts they have already passed in the first call or discard them.

End-of-program exam

The assessment system will be the same as the global assessment of the ordinary exam.

Other comments

The grades obtained are only valid for the current academic year.

The use of any material during the tests will have to be explicitly authorized.

Plagiarism is regarded as serious dishonest behavior. If any form of plagiarism is detected in any of the tests or exams, the final grade will be FAIL (0), and the incident will be reported to the corresponding academic authorities for prosecution.

Sources of information

Basic Bibliography

Rolando Herrero, **Fundamentals of IoT Communication Technologies**, https://doi.org/10.1007/978-3-030-70080-5, 1, Springer Cham, 2021

Kevin Townsend, Carles Cufí, Akiba, Robert Davidson, **Getting Started with Bluetooth Low Energy**, 9781491900581, 1, O'Reilly Media, Inc., 2014

Complementary Bibliography

Cory Beard, **Wireless Communication Networks and Systems**, 978-1292108711, 1, Pearson, 2016

Hanes D., Salgueiro G., Patrick Grossetete P., Henry J., Barton R, **IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things**, 978-1-58714-456-1, 1, Cisco Press, 2017

Rolando Herrero, **Practical Internet of Things Networking**, https://doi.org/10.1007/978-3-031-28443-4, 1, Springer Cham, 2023

Kersten Heins, **NB-IoT Use Cases and Devices**, https://doi.org/10.1007/978-3-030-84973-3, 1, Springer Cham, 2021

Recommendations

IDENTIFYING DATA				
(*)Protocolos de comunicacións para IoT				
Subject	(*)Protocolos de comunicacións para IoT			
Code	V05M200V01104			
Study programme	(*)Máster Universitario en Internet das Cousas- IoT			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	4.5	Mandatory	1st	1st
Teaching language	Spanish Galician			
Department				
Coordinator	López Ardao, José Carlos			
Lecturers	Herrería Alonso, Sergio López Ardao, José Carlos Suárez González, Andrés			
E-mail	jardao@det.uvigo.es			
Web	http://moovi.uvigo.gal/			
General description	In this mandatory subject, students learn the knowledge, skills and competences necessary to implement network architectures for IoT systems, selecting the most appropriate network topologies and routing and application protocols for each scenario, and to design and develop network applications in the IoT field, using the most common protocols.			

Training and Learning Results	
Code	
B6	CNC6: Recognise the operation of the different network and application
C7	HBL7: Select network topologies and routing and application protocols suitable for IoT scenarios.
C12	HBL12: Apply the acquired knowledge and solve problems in new or unfamiliar environments within broader, multidisciplinary contexts, being able to integrate knowledge.
D2	CMP2: Develop the necessary architecture to ensure device interoperability.
D3	CMP3: Build networks and define protocols to enable communication between IoT devices.

Expected results from this subject	
Expected results from this subject	Training and Learning Results
Implement network architectures for IoT systems	B6 D2 D3
Select network topologies and routing and application protocols suitable for IoT scenarios.	C7
Design and develop network applications in the IoT field, using the most common protocols.	B6 C12 D2 D3

Contents	
Topic	
Topic 1: Introduction to IoT networks	1.1. Types of networks 1.2. Devices: Sensors, actuators/controllers and Gateways 1.3. Wireless Sensor Networks
Topic 2: Network and Transport Layers	2.1. IPv6 2.2. 6LoWPAN 2.3. The Transport Layer
Topic 3: Application Layer	3.1. Architectures 3.2. Request/Response: REST, HTTP, CoAP, OPC UA, etc. 3.3. Publish/Subscribe: MQTT, AMQP
Topic 4: Resource Identification and Management	4.1. IoT Services and Resources 4.2. mDNS 4.3. SD-DNS 4.4. CoAP Service Discovery 5.5. UPnP

Topic 5: Routing on Constrained Devices	5.1. Routing Concepts 5.2. Routing in Wireless Sensor Networks 5.3. RPL (Routing Protocol for Low-Power and Lossy Networks)

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	21	34.5	55.5
Problem solving	6	12	18
Autonomous problem solving	0	12	12
Practices through ICT	6	18	24
Essay questions exam	2	0	2
Objective questions exam	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	
	Description
Lecturing	Presentation of the ideas, concepts, techniques and algorithms of each of the thematic units of the course. This methodology will be used to work on all the Learning Results (LRs) of the subject.
Problem solving	Resolution in the classroom by the teacher of problems related to the subject. This methodology will be used to work on all the LRs of the subject.
Autonomous problem solving	Resolution of problems and self-assessable tests in the virtual classroom that must be carried out by the students individually, autonomously and without attendance, always with a deadline. These activities have an overall weight of 15% in the case of continuous assessment. With this methodology all the LRs of the subject will be worked.
Practices through ICT	Development of small network applications in the field of IoT, using the most common protocols. With this methodology all the LRs of the subject will be worked on

Personalized assistance	
Methodologies	**Description**
Lecturing	Personalized attention will be provided individually, in person or by videoconference. Students can request tutoring sessions to the faculty of the subject by messaging or e-mail.
Problem solving	Personalized attention will be provided individually, in person or by videoconference. Students can request tutoring sessions to the faculty of the subject by messaging or e-mail.
Autonomous problem solving	In the case of online assignments, a detailed solution of all tasks will be provided in the virtual classroom. tasks. In the case of self-assessment tests, the tests will be designed to provide the student with the appropriate feedback to the student on the failed questions. In any case, it is also possible to attend personalized attention on an individual basis, in person or by videoconference. Students can request tutoring sessions to the teaching staff of the subject by messaging or e-mail.
Practices through ICT	Personalized attention will be provided individually, in person or by videoconference. Students can request tutoring sessions to the faculty of the subject by messaging or e-mail.

Assessment				
	Description	Qualification	Training and Learning Results	
Autonomous problem solving	Throughout the two-month period, self-assessable tasks and tests are given in the virtual classroom that must be carried out by the students individually, autonomously and without attendance, always with a deadline. These tasks have an overall weight of 10%.	10	B6 C7	D2 D3
Practices through ICT	Throughout the two-month period, the development of small network applications in the IoT field is proposed, using the most common application protocols. There will be several face-to-face sessions to explain the related programming concepts, and also to solve doubts with the teacher. These practices have an overall weight of 30%.	30	B6 C7 C12	D2 D3
Essay questions exam	Final exam covering the entire subject. It has a weight of 40% but a minimum grade of 4 out of 10 is a minimum grade of 4 points out of 10 is required to pass the course.	40	B6 C7 C12	D2 D3
Objective questions exam	In the middle of the two-month period, a one-hour test will be given to control the follow-up of the subject. This control test has a weight of 20%.	20	B6 C7	D2 D3

Other comments on the Evaluation

The Final Grade of the subject is calculated as the weighted average of the grades of each section if the grade of the Final Exam is greater or equal to 4. If it is lower, the Final Grade will be the minimum between 4.9 and the previous weighted average.

A student is considered to opt for Continuous Assessment (CA) if he/she takes the intermediate follow-up control test. Otherwise, the student is considered to opt for Global Assessment (GA).

The Global Assessment (GA) will consist of taking the Final Exam and the grade will be the one obtained in that exam.

Extraordinary Opportunity

In the month of July there will be a new Final Exam on the officially established dates that can only be taken by those students who have not passed the subject in the ordinary opportunity.

Those students who have failed in the ordinary opportunity going by Continuous Assessment and wish to waive it to choose the Global Assessment, will have to request it in writing to the coordinator of the subject before the review date of the final exam of the ordinary opportunity.

Other considerations

All students who sit for either of the two final exams are considered to have passed the course. The grades of all exams, assignments, practices and non face-to-face activities will only have effects in the academic year in which they are proposed.

The virtual classroom platform has tools to detect possible anomalous and dishonest behavior in the self-assessment tests (tests taken by several people, answers known in advance, etc.), as well as to detect possible plagiarism in written work or software programs.

In case of detection of plagiarism in any of the works/quizzes/exams/tests taken, including the non face-to-face activities delivered or carried out in the virtual classroom, the final grade of the subject will be Fail (0) and the teachers will communicate the matter to the Head of the School so that the appropriate measures can be taken.

In case of any contradiction that may have occurred between the different versions of the guide, due to an error in the translation, the version that will prevail is the version in Galician language.

Sources of information

Basic Bibliography

Rolando Herrero, **Fundamentals of IoT Communication Technologies**, 10.1007/978-3-030-70080-5, 1, Springer, 2021

Complementary Bibliography

Sudip Misra, Anandarup Mukherjee, Arijit Roy, **Introduction to IoT**, 10.1017/9781108913560, 1, Cambridge University Press, 2021

MQTT, https://mqtt.org/,

Recommendations

IDENTIFYING DATA

Computación na nube para IoT

Subject	Computación na nube para IoT			
Code	V05M200V01105			
Study programme	Máster Universitario en Internet das Cousas- IoT			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Mandatory	1	1c
Teaching language				
Department				
Coordinator	López Ardao, José Carlos			
Lecturers				
E-mail				
Web	http://https://guiadocente.udc.es/guia_docent/index.php?centre=614&ensenyament=614557&assignatura=614557003&any_academic=2024_25&idioma=cast&any_academic=2024_25			
General description	Materia coordinada pola UDC. A guía docente está dispoñible no enlace indicado arriba			

Resultados de Formación e Aprendizaxe

Code

Resultados previstos na materia

Expected results from this subject	Training and Learning Results

Contidos

Topic

Planificación

	Class hours	Hours outside the classroom	Total hours

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Metodoloxía docente

	Description

Atención personalizada

Avaliación

Description	Qualification	Training and Learning Results

Other comments on the Evaluation

Bibliografía. Fontes de información

Basic Bibliography

Complementary Bibliography

Recomendacións

IDENTIFYING DATA				
Innovación e emprendemento tecnolóxico en IoT				
Subject	Innovación e emprendemento tecnolóxico en IoT			
Code	V05M200V01106			
Study programme	Máster Universitario en Internet das Cousas- IoT			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Mandatory	1	1c
Teaching language				
Department	Enxeñaría telemática			
Coordinator	Caeiro Rodríguez, Manuel			
Lecturers	Caeiro Rodríguez, Manuel			
E-mail	mcaeiro@det.uvigo.es			
Web	http://https://www.usc.gal/es/plan/19398/course/75/subject/19399-18493-2-103886			
General description	Materia coordinada pola USC. A guía docente está dispoñible no enlace indicado arriba			

Resultados de Formación e Aprendizaxe
Code

Resultados previstos na materia	
Expected results from this subject	Training and Learning Results

Contidos
Topic

Planificación			
	Class hours	Hours outside the classroom	Total hours
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Metodoloxía docente	
	Description

Atención personalizada

Avaliación		
Description	Qualification	Training and Learning Results

Other comments on the Evaluation

Bibliografía. Fontes de información
Basic Bibliography
Complementary Bibliography

Recomendacións

IDENTIFYING DATA				
(*)Sistemas empotrados				
Subject	(*)Sistemas empotrados			
Code	V05M200V01107			
Study programme	(*)Máster Universitario en Internet das Cousas- IoT			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	4.5	Mandatory	1st	1st
Teaching language	Spanish Galician			
Department				
Coordinator	Valdés Peña, María Dolores			
Lecturers	Cao Paz, Ana María Costas Pérez, Lucía Quintáns Graña, Camilo Valdés Peña, María Dolores			
E-mail	mvaldes@uvigo.es			
Web	http://moovi.uvigo.gal/course			
General description	In this subject, the basic concepts of embedded systems aimed at IoT applications are introduced. They are analyzed both from the hardware point, using Espressif's ESP32 architecture as an example, and from the software through the study of a specific work environment. The subject has an eminently practical nature.			

Training and Learning Results	
Code	
B5	CNC5: Recognise the structure of embedded IoT systems.
C5	HBL5: Develop embedded systems for IoT applications.
C12	HBL12: Apply the acquired knowledge and solve problems in new or unfamiliar environments within broader, multidisciplinary contexts, being able to integrate knowledge.
D4	CMP4: Evaluate the performance of IoT embedded electronic systems.

Expected results from this subject	Training and Learning Results
Know the basic architectures of embedded systems used in IoT applications	B5
Know how to connect sensors and actuators to the core of an embedded system	B5 C5 C12 D4
Know concepts associated with data storage in an IoT system	B5 C5
Design embedded systems based on microcontrollers (ESP32 family)	B5 C5 C12
Know how to analyze the performance and global power consumption of an embedded system	D4
Know the concept of a real-time operating system	B5 C5 C12
Design an embedded system that performs real time tasks	B5 C5 C12 D4

Contents	
Topic	
Introduction to embedded systems	- Architectures of embedded systems for IoT - ESP32 microcontroller - FreeRTOS operating system - Application development environments

ESP32 microcontroller architecture	- Internal structure - Memory management - Basic peripherals - Interrupt system - Communication and connection with external circuits, sensors and actuators
RTOS systems	- Basic concepts: tasks, memory management, queues, semaphores. - Using the ESP32 with FreeRTOS
Low power modes	- ESP32 low power modes - Performance and total consumption evaluation
Laboratory practices	- Introduction to the use of ESP32 and the design and debugging environment - Design of an embedded system for IoT applications

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	18	18	36
Laboratory practical	12	30	42
Mentored work	6	18.5	24.5
Report of practices, practicum and external practices	0	10	10

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies

	Description
Lecturing	The teaching staff presents the theoretical content of the subject, encouraging critical discussion and student participation. As a prior task, the documentation for each session will be available on the subject's website and the student is expected to attend the class by reading it previously. In lecturing sessions, skills B5 and C12 are worked on.
Laboratory practical	In the laboratory sessions, the students apply the design methods described in the master classes. All sessions are guided and supervised by teachers. In the laboratory practices, skills B5, C5 and C12 are worked on.
Mentored work	This activity focuses on applying the design techniques studied in the theoretical classes and the skills acquired at the laboratory to a project implementation. Students should obtain well founded solutions, choosing appropriate methods and devices. Through this activity the outcomes B5, C5, C12 and D4 are developed.

Personalized assistance

Methodologies	Description
Lecturing	Students have the opportunity to resolve their doubts in personalized attention sessions. The appointment with the corresponding teacher must be requested and confirmed by email, preferably during the schedule published on the center's website. Links to faculty contact details are available on the subject website.
Laboratory practical	Students have the opportunity to resolve their doubts in personalized attention sessions. The appointment with the corresponding teacher must be requested and confirmed by email, preferably during the schedule published on the center's website. Links to faculty contact details are available on the subject website.
Mentored work	Students have the opportunity to resolve their doubts in personalized attention sessions. The appointment with the corresponding teacher must be requested and confirmed by email, preferably during the schedule published on the center's website. Links to faculty contact details are available on the subject website.

Assessment

	Description	Qualification	Training and Learning Results
Laboratory practical	These tests are carried out during the laboratory practice sessions. The assessment of the tasks suggested in the script of each practice represents 30% of the final grade.	30	B5 C5 D4 C12

Mentored work	This activity focuses on applying the design techniques studied in the theoretical classes and the skills acquired at the laboratory to a project implementation. The project focuses on the design and implementation of an embedded system for a specific application and represents 40% of the final grade for the subject.	40	B5	C5 C12	D4
Report of practices, practicum and external practices	Students must submit a report of each practical session describing the solutions carried out, the methodologies used and the results obtained. This activity represents 30% of the final grade.	30	B5	C5	D4

Other comments on the Evaluation

The subject can be passed with the maximum grade through continuous assessment (CA) or global assessment (GA). Both evaluation methods are exclusive. The student who attends more than 2 laboratory sessions is considered to have opted for continuous assessment. However, those who wish to waive continuous assessment may do so within a maximum of one month before the end of the semester.

1. Continuous assessment (CA)

Students who opt for the CA modality will have two evaluation opportunities, the ordinary call at the end of the two-month period and the extraordinary one at the end of the course.

1.1 Ordinary call:

The ordinary call consists of a set of assessments that will be carried out throughout the two-month period. The dates of all the tests will be published in a shared calendar and will be available at the beginning of the course. The weight and content of the assesssments is as follows:

- *Laboratory practices* (NPrac):

- Students must correctly implement the circuits described in the practice scripts. The grade of each practice depends on these results.
- It can be done individually or in groups of 2 or more students. In the latter case, all students who attend the practice will have the same NPrac grade.
- The practices are compulsory. Students must attend at least 80% of the practice sessions.
- The NPrac grade is calculated as the average of the grades obtained in each practice.

- *Practice report* (NInf):

- The student must submit the results report corresponding to each laboratory practice.
- This report can only be delivered if the student has attended and completed the practice.
- If the practice has been carried out in a group of 2 or more students, the NInf grade will be the same for all members of the group who attended the practice and performed it.
- The NInf grade is calculated as the average of the grades obtained in each report.

- *Project (mentored work)* (NPro):

- The students will carry out a design project of an embedded system aimed at an IoT application.
- The students will carry out the project autonomously under the tutoring of the responsible faculty.
- It can be done individually or in groups of 2 or more students.

Continuous assessment final grade (Final_CA):

The final grade of the ordinary CA is obtained as follows:

Final_CA = (NPrac*0.3 + NInf*0.3 + NPro*0.4) if NPrac, NInf and NPro are is equal to or greater than 4 and Final_CA is equal to or greater than 5;

Final_CA = min [(NPrac*0.3 + NInf*0.3 + NPro*0.4), 4.9] in any other case.

1.2 Extraordinary call:

Student who do not pass one or more assessments of the ordinary call can recover the following parts in the extraordinary

one:

- They can take a practical exam (NExam) and the new grade replaces the previous ones (NPrac + NInf).
- They can complete the project and this grade replaces the previous one (NPro).

The final grade of the extraordinary CA is obtained as follows:

Final_CA = (NExam*0.6 + NPro*0.4) if NExam and NPro are equal to or greater than 4 and Final_CA is equal to or greater than 5.

Final_CA = min [(NExam*0.6 + NPro*0.4), 4.9] in any other case.

2. Global assessment (GA)

As with the continuous assessment, students who opt for global assessment will have two opportunities, ordinary and extraordinary calls. In both cases it will consist of the following parts:

- A practical exam covering the same aims of the laboratory practices developed during the course. This exam evaluates the theoretical and practical contents of the subject. The weight of this assessment (NExam) represents 60% of the final grade.
- An individual project with the same objectives and complexity as the project carried out in continuous assessment. This project (NPro) represents 40% of the final grade.

Global assessment final grade (Final_GA):

The final grade of the global assessment is obtained as follows:

Final_GA = (NExam*0.6 + NPro*0.4) if NExam and NPro are equal to or greater than 4 and Final_GA is equal to or greater than 5;

Final_GA = min [(NExam*0.6 + NPro*0.4), 4.9] in any other case.

3. Other comments:

- Students may write their reports, papers, exams or presentations in Spanish, Galician or English.
- The grades obtained in the continuous or global assessment are only valid for the current academic year.
- Plagiarism is regarded as serious dishonest behavior. In the case that plagiarism is detected in any of the reports/tasks/exams done/taken, the final grade will be FAIL (0), and the incident will be reported to the corresponding academic authorities for prosecution.

Sources of information

Basic Bibliography

Espressif Systems, **ESP32-S3 Technical Reference Manual**, Version 1.5, 2024

Complementary Bibliography

Recommendations

Subjects that are recommended to be taken simultaneously

(*)Dispositivos IoT/V05M200V01101

IDENTIFYING DATA				
Enxeñaría de datos para IoT				
Subject	Enxeñaría de datos para IoT			
Code	V05M200V01108			
Study programme	Máster Universitario en Internet das Cousas- IoT			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Mandatory	1	1c
Teaching language				
Department	Enxeñaría telemática			
Coordinator	Caeiro Rodríguez, Manuel			
Lecturers	Caeiro Rodríguez, Manuel			
E-mail	mcaeiro@det.uvigo.es			
Web	http://https://guiadocente.udc.es/guia_docent/index.php?centre=614&ensenyament=614557&assignatura=614557008&any_academic=2024_25&idioma=cast&any_academic=2024_25			
General description	Materia coordinada pola UDC. A guía docente está dispoñible no enlace indicado arriba			

Resultados de Formación e Aprendizaxe
Code

Resultados previstos na materia	
Expected results from this subject	Training and Learning Results

Contidos
Topic

Planificación			
	Class hours	Hours outside the classroom	Total hours
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Metodoloxía docente	
	Description

Atención personalizada

Avaliación		
Description	Qualification	Training and Learning Results

Other comments on the Evaluation

Bibliografía. Fontes de información
Basic Bibliography
Complementary Bibliography

Recomendacións

IDENTIFYING DATA				
(*)Aprendizaxe automático				
Subject	(*)Aprendizaxe automático			
Code	V05M200V01201			
Study programme	(*)Máster Universitario en Internet das Cousas- IoT			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	4.5	Mandatory	1st	2nd
Teaching language	Spanish			
Department				
Coordinator	Burguillo Rial, Juan Carlos			
Lecturers	Burguillo Rial, Juan Carlos Gil Solla, Alberto			
E-mail	jrial@uvigo.es			
Web	http://https://guiadocente.udc.es/guia_docent/index.php?centre=614&ensenyament=614557&assignatura=614557009&any_academic=2024_25&idioma=cast&any_academic=2024_25			
General description	The subject introduces students to machine learning techniques. In particular, the aim is for the student, at the end of the subject, to be able to: - Know and understand the fundamental concepts of machine learning for IoT. - Implement supervised/unsupervised machine learning algorithms with classical and deep neural networks. - Apply the knowledge acquired and solve problems in new or little-known environments within broader and multidisciplinary contexts, being able to integrate knowledge. The subject will be taught in Spanish.			

Training and Learning Results	
Code	
B11	CNC11: To know and understand the fundamental concepts on machine learning for IoT.
C11	HBL11: Implement supervised/unsupervised machine learning algorithms with classical and deep neural networks. deep.
C12	HBL12: Apply the acquired knowledge and solve problems in new or unfamiliar environments within broader, multidisciplinary contexts, being able to integrate knowledge.
D6	CMP6: Integrate technologies such as Machine Learning, massive data processing, Distributed Logging Technologies (DLT), edge computing, among others, for the development of more intelligent and efficient IoT systems.

Expected results from this subject	Training and Learning Results
Integrate technologies such as Machine Learning, massive data processing, Distributed Record Technologies (DLT), edge computing, among others, for the development of smarter and more efficient IoT systems.	B11 C11 C12 D6

Contents	
Topic	
Introduction to machine learning	Methodologies for the development of models
Data preprocesing	Techniques for dimensionality reduction
Types of learning	Supervised: classification and regression. Unsupervised learning. Reinforcement learning.
Artificial neural networks	Types of basic networks. Deep learning.
Introduction to edge learning	Distributed/Federated learning

Planning	Class hours	Hours outside the classroom	Total hours
Lecturing	24	50	74
Laboratory practical	12	0	12
Mentored work	0	25	25
Objective questions exam	1.5	0	1.5
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description

Lecturing	It will consist of the explanation of the different sections of the subject program, with the help of electronic media (presentations, videos, etc.). This activity will be done individually. The competence involved is B11.
Laboratory practical	Different practical problems related to the content of the subject will be posed for the student to solve individually or in groups. The skills involved are C11 and C12.
Mentored work	The scope and objectives of the projects, use cases and/or practical problems will require autonomous work by students, although with the supervision of the teaching staff. This activity will be done individually or in groups. The competence involved is D6.

Personalized assistance

Methodologies	Description
Lecturing	In the practical training activities and tutorials, the subject teachers will offer personal guidance to each student in the tasks to be carried out, with the aim of guiding the approach and methodology. They will also offer coordination information with other content and subjects of the study program. It is recommended to consult doubts with teachers throughout the course to improve understanding of the basic concepts, and to carry out the tasks and activities to be evaluated. Students can request tutoring support through the Moovi platform (https://moovi.uvigo.gal).
Laboratory practical	In the practical training activities and tutorials, the subject teachers will offer personal guidance to each student in the tasks to be carried out, with the aim of guiding the approach and methodology. They will also offer coordination information with other content and subjects of the study program. It is recommended to consult doubts with teachers throughout the course to improve understanding of the basic concepts, and to carry out the tasks and activities to be evaluated. Students can request tutoring support through the Moovi platform (https://moovi.uvigo.gal).
Mentored work	In the practical training activities and tutorials, the subject teachers will offer personal guidance to each student in the tasks to be carried out, with the aim of guiding the approach and methodology. They will also offer coordination information with other content and subjects of the study program. It is recommended to consult doubts with teachers throughout the course to improve understanding of the basic concepts, and to carry out the tasks and activities to be evaluated. Students can request tutoring support through the Moovi platform (https://moovi.uvigo.gal).
Tests	**Description**
Objective questions exam	In the practical training activities and tutorials, the subject teachers will offer personal guidance to each student in the tasks to be carried out, with the aim of guiding the approach and methodology. They will also offer coordination information with other content and subjects of the study program. It is recommended to consult doubts with teachers throughout the course to improve understanding of the basic concepts, and to carry out the tasks and activities to be evaluated. Students can request tutoring support through the Moovi platform (https://moovi.uvigo.gal).

Assessment

	Description	Qualification	Training and Learning Results
Lecturing	A theoretical exam will be carried out at the end of the course on the contents of the subject. It will be composed of short and/or multiple choice selection questions, and development questions where the student will describe one or several concepts, relating them to each other, and illustrating them with examples.	40	B11
Laboratory practical	Students will carry out a set of computer laboratory practices, where they will work on the concepts studied throughout the master classes.	35	C11 C12
Mentored work	Students will carry out work, individually or in groups, on the concepts studied throughout the master classes and those that have been analyzed in the computer laboratory practices.	25	D6

Other comments on the Evaluation

Continuous assessment:

To pass the subject, the student must complete and approve the proposed practical and tutored work, which represents 60% of the final grade (35% practicas and 25% mentored work), as well as pass the final exam, which constitutes the remaining 40%. To do this, it will be necessary to obtain a grade equal to or greater than 5 in the overall grade. In addition, it is required to achieve at least a 4 in each of the parts (theory, practices and mentored work) so that it can be averaged.

The questions of the final exam will focus on the specific content that has been developed in the subject in relation to its

competencies and that may have been acquired by the student in both the expository and interactive parts.

Partial exams: Due to the bimonthly nature of the subject, no partial exam will be carried out.

Extraordinary evaluation:

Only the grade achieved in the practices (practical and supervised work) during the course is maintained and also its weight in the final grade. Students who have not reached the cut-off mark in the activities proposed during the previous call may submit, on a date prior to the second chance final exam, activities similar to those not passed, which will be proposed by the teachers.
The questions of the final exam will focus on the specific content that has been developed in the subject in relation to its competencies and that may have been acquired by the student in both the expository and interactive parts.

End of program evaluation:

Students repeating and/or with attendance exemption will be examined under the same conditions as students in the first call.

Not presented:

The student will receive the qualification of "not presented" when the final exam is not taken.

Fraudulent performance of exercises or tests:

In cases of fraudulent completion of exercises or tests, the provisions of the official performance evaluation regulations of each institution will apply. In particular, if any form of plagiarism is detected in any of the tests or exams, the final grade will be FAIL (0), and the incident will be reported to the corresponding academic authorities.

Sources of information

Basic Bibliography

Alpaydin, E., **Introduction to machine learning**, 3ra, MIT press, 2010

Sutton, R. S., Barto, A. G., **Reinforcement learning: An introduction**, 2da, MIT press, 2018

Complementary Bibliography

Zhang, A., Lipton, Z. C., Li, M., Smola, A. J., **Dive into deep learning**, arXiv:2106.11342, arXiv preprint, 2021

Brink, H., Richards, J., & Fetherolf, M., **Real-world machine learning**, Shelter Island, NY: Manning, 1017

Yang, Q., Liu, Y., Chen, T., Tong, Y., **Federated machine learning: Concept and applications**, 10(2), 1-19, ACM, 2019

Yang Q., Liu Y., Cheng Y., Kang, Y, Chen T. Yu H., **Federated Learning**, https://doi.org/10.1007/978-3-031-01585-4, Springer, 2020

Recommendations

Other comments

The student should bring the subject up to date to be able to apply the knowledge acquired in the theory classes in the practical exercises.

IDENTIFYING DATA				
Ciberseguridade en IoT				
Subject	Ciberseguridade en IoT			
Code	V05M200V01202			
Study programme	Máster Universitario en Internet das Cousas- IoT			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	4.5	Mandatory	1	2c
Teaching language				
Department	Enxeñaría telemática			
Coordinator	Caeiro Rodríguez, Manuel			
Lecturers	Caeiro Rodríguez, Manuel			
E-mail	mcaeiro@det.uvigo.es			
Web	http://https://guiadocente.udc.es/guia_docent/index.php?centre=614&ensenyament=614557&assignatura=614557010&any_academic=2024_25&idioma=cast&any_academic=2024_25			
General description	Materia coordinada pola UDC. A guía docente está dispoñible no enlace indicado arriba			

Resultados de Formación e Aprendizaxe
Code

Resultados previstos na materia	
Expected results from this subject	Training and Learning Results

Contidos
Topic

Planificación			
	Class hours	Hours outside the classroom	Total hours
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Metodoloxía docente	
	Description

Atención personalizada

Avaliación		
Description	Qualification	Training and Learning Results

Other comments on the Evaluation

Bibliografía. Fontes de información
Basic Bibliography
Complementary Bibliography

Recomendacións

IDENTIFYING DATA				
Smart Health para IoT				
Subject	Smart Health para IoT			
Code	V05M200V01203			
Study programme	Máster Universitario en Internet das Cousas- IoT			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Optional	1	2c
Teaching language				
Department	Enxeñaría telemática			
Coordinator	Santos Gago, Juan Manuel			
Lecturers	Santos Gago, Juan Manuel			
E-mail	Juan.Santos@det.uvigo.es			
Web	http://https://www.usc.gal/es/plan/19398/course/75/subject/19400-18494-3-103890			
General description	Materia coordinada pola USC. A guía docente está dispoñible no enlace indicado arriba			

Resultados de Formación e Aprendizaxe
Code

Resultados previstos na materia	
Expected results from this subject	Training and Learning Results

Contidos
Topic

Planificación			
	Class hours	Hours outside the classroom	Total hours
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Metodoloxía docente	
	Description

Atención personalizada

Avaliación		
Description	Qualification	Training and Learning Results

Other comments on the Evaluation

Bibliografía. Fontes de información
Basic Bibliography
Complementary Bibliography

Recomendacións

IDENTIFYING DATA

Smart Cities

Subject	Smart Cities			
Code	V05M200V01204			
Study programme	Máster Universitario en Internet das Cousas- IoT			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Optional	1	2c
Teaching language				
Department	Enxeñaría telemática			
Coordinator	Santos Gago, Juan Manuel			
Lecturers	Santos Gago, Juan Manuel			
E-mail	Juan.Santos@det.uvigo.es			
Web	http://https://guiadocente.udc.es/guia_docent/index.php?centre=614&ensenyament=614557&assignatura=614557018&any_academic=2024_25&idioma=cast&any_academic=2024_25			
General description	Materia coordinada pola UDC. A guía docente está dispoñible no enlace indicado arriba			

Resultados de Formación e Aprendizaxe

Code

Resultados previstos na materia

Expected results from this subject	Training and Learning Results

Contidos

Topic

Planificación

	Class hours	Hours outside the classroom	Total hours

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Metodoloxía docente

	Description

Atención personalizada

Avaliación

Description	Qualification	Training and Learning Results

Other comments on the Evaluation

Bibliografía. Fontes de información

Basic Bibliography

Complementary Bibliography

Recomendacións

IDENTIFYING DATA				
Edificios e fogares intelixentes				
Subject	Edificios e fogares intelixentes			
Code	V05M200V01205			
Study programme	Máster Universitario en Internet das Cousas- IoT			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Optional	1	2c
Teaching language				
Department	Enxeñaría telemática			
Coordinator	Santos Gago, Juan Manuel			
Lecturers	Santos Gago, Juan Manuel			
E-mail	Juan.Santos@det.uvigo.es			
Web	http://https://www.usc.gal/es/plan/19398/course/75/subject/19400-18494-3-103892			
General description	Materia coordinada pola USC. A guía docente está dispoñible no enlace indicado arriba			

Resultados de Formación e Aprendizaxe
Code

Resultados previstos na materia	
Expected results from this subject	Training and Learning Results

Contidos
Topic

Planificación			
	Class hours	Hours outside the classroom	Total hours
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Metodoloxía docente	
	Description

Atención personalizada

Avaliación		
Description	Qualification	Training and Learning Results

Other comments on the Evaluation

Bibliografía. Fontes de información
Basic Bibliography
Complementary Bibliography

Recomendacións

IDENTIFYING DATA				
Big data para a sociedade 5.0				
Subject	Big data para a sociedade 5.0			
Code	V05M200V01206			
Study programme	Máster Universitario en Internet das Cousas- IoT			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Optional	1	2c
Teaching language				
Department				
Coordinator	López Ardao, José Carlos			
Lecturers				
E-mail				
Web	http://https://www.usc.gal/es/plan/19398/course/75/subject/19400-18494-3-106199			
General description	Materia coordinada pola USC. A guía docente está dispoñible no enlace indicado arriba			

Resultados de Formación e Aprendizaxe
Code

Resultados previstos na materia	
Expected results from this subject	Training and Learning Results

Contidos
Topic

Planificación			
	Class hours	Hours outside the classroom	Total hours
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Metodoloxía docente	
	Description

Atención personalizada

Avaliación		
Description	Qualification	Training and Learning Results

Other comments on the Evaluation

Bibliografía. Fontes de información
Basic Bibliography
Complementary Bibliography

Recomendacións

IDENTIFYING DATA				
Prácticas en empresa para sociedade 5.0				
Subject	Prácticas en empresa para sociedade 5.0			
Code	V05M200V01207			
Study programme	Máster Universitario en Internet das Cousas- IoT			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Optional	1	2c
Teaching language				
Department	Tecnoloxía electrónica			
Coordinator	Marcos Acevedo, Jorge			
Lecturers	Marcos Acevedo, Jorge			
E-mail	acevedo@uvigo.es			
Web	http://https://www.usc.gal/es/plan/19398/course/75/subject/19400-18494-3-106195			
General description	Materia coordinada pola USC. A guía docente está dispoñible no enlace indicado arriba			

Resultados de Formación e Aprendizaxe
Code

Resultados previstos na materia	
Expected results from this subject	Training and Learning Results

Contidos
Topic

Planificación			
	Class hours	Hours outside the classroom	Total hours
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Metodoloxía docente
Description

Atención personalizada

Avaliación		
Description	Qualification	Training and Learning Results

Other comments on the Evaluation

Bibliografía. Fontes de información
Basic Bibliography
Complementary Bibliography

Recomendacións

IDENTIFYING DATA				
(*)Traballo Fin de máster				
Subject	(*)Traballo Fin de máster			
Code	V05M200V01208			
Study programme	(*)Máster Universitario en Internet das Cousas- IoT			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	1st	2nd
Teaching language	Spanish Galician English			
Department				
Coordinator	Herrería Alonso, Sergio			
Lecturers				
E-mail				
Web				
General description	The Master's Final Project (TFM) is an original and personal project that each student carries out autonomously under the supervision of a lecturer, and must enable them to demonstrate in an integrated way the acquisition of the training content and competences associated with the degree.			

Training and Learning Results	
Code	
B12	CNC12: Acquire advanced knowledge and demonstrate, in a scientific and technological or highly scientific and technological research or highly specialised research context, a detailed and grounded understanding of theoretical and practical theoretical and practical aspects and methodology of work in one or more fields of study. or more fields of study.
C12	HBL12: Apply the acquired knowledge and solve problems in new or unfamiliar environments within broader, multidisciplinary contexts, being able to integrate knowledge.
C13	HBL13: Communicate (orally and in written form) the conclusions-and the ultimate knowledge and reasons that support them - to specialized and non-specialized audiences in a clear and unambiguous way.
D11	CMP11: Develop sufficient autonomy to participate in research projects and scientific or technological collaborations within their thematic area, in interdisciplinary contexts and, where appropriate, with a high component of knowledge transfer.
D12	CMP12: To integrate knowledge and to face the complexity of formulate judgments based on information that, being incomplete or limited, includes reflections on the social and ethical responsibilities linked to the application of knowledge and judgments.
D13	CMP13: Assume responsibility for one's own professional development and specialization in one or more fields of study, in a continuous, self-directed and autonomous way.

Expected results from this subject	Training and Learning Results
Definition of the project: aims, scope and methodological approach.	D12 D13
Realisation of the project: analysis and modelling of the problem, application of the knowledges, skills and competitions purchased, and management and follow-up of the development of the project.	B12 C12 C13 D11 D12 D13
Writing of the final report.	C13 D12
Public presentation of the work.	C13 D12

Contents
Topic

The contents of the TFM are defined in the individual proposals offered by the individual proposals offered by the tutors, according to the tutors, in accordance with the regulations laid down by the by the Master's Academic Committee.	The theme of each paper is specific, given the individual nature of the work.

Planning			
	Class hours	Hours outside the classroom	Total hours
Mentored work	0	80	80
Previous studies	0	20	20
Case studies	0	10	10
Autonomous problem solving	0	10	10
Presentation	0	29	29
Presentation	0	1	1
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Mentored work	Original and personal work that each student carries out autonomously under the supervision of a teacher.
Previous studies	Searching, reading and working on documentation, problem-solving proposals and/or exercises to be carried out in the classroom or laboratory independently by the students.
Case studies	A critical analysis of problems similar to the one posed in the dissertation is carried out in order to extract ideas, analogies, methods or partial results that help in the resolution of the problem posed in the TFM.
Autonomous problem solving	The student studies the possible solutions to a scientific-technical problem proposed for his/her dissertation, and elaborates a synthesis solution (analytical, meteorological, experimental or combined) that will that allows him/her to achieve the objectives that he/she had foreseen.
Presentation	The student writes a final report or descriptive memory of the work made

Personalized assistance	
Methodologies	**Description**
Mentored work	Each student will meet periodically with their tutors to receive guidance, orientation or help on the objectives, methodology, analysis of results and presentation of the work.
Presentation	Each student will meet periodically with their tutors to receive guidance, guidance or help on the writing of the final report and the presentation of the work.

Assessment					
	Description	Qualification	Training and Learning Results		
Mentored work	Assessment of the work made and of the descriptive memory or final report of the TFM	60	B12	C12 C13	D11 D12 D13
Presentation	Assessment of the public presentation of the TFM (20%) and of the answers of the student to the questions formulated after the public presentation (20%)	40		C13	

Other comments on the Evaluation

The assessment will be made by means of the presentation and defence before a Tribunal of the individual work carried out by the student under the supervision of a lecturer from the degree, or a lecturer or engineer from outside the University, represented by a lecturer from the master.

In the assessment, the examining board may take into account the opinions or the reasoned report of the tutor lecturer, as well as aspects such as the quality of the presentation, the review of the state of the art, the quality of the technical proposal, the novelty and relevance of the results, the student's capacity for initiative, etc.

Sources of information

Basic Bibliography

Complementary Bibliography

Recommendations

IDENTIFYING DATA				
Análise de video para aplicacións da sociedade 5.0				
Subject	Análise de video para aplicacións da sociedade 5.0			
Code	V05M200V01209			
Study programme	Máster Universitario en Internet das Cousas- IoT			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Optional	1	2c
Teaching language				
Department				
Coordinator	López Ardao, José Carlos			
Lecturers				
E-mail				
Web	http://https://www.usc.gal/es/plan/19398/course/75/subject/19400-18494-3-106198			
General description	Materia coordinada pola USC. A guía docente está dispoñible no enlace indicado arriba			

Resultados de Formación e Aprendizaxe
Code

Resultados previstos na materia	
Expected results from this subject	Training and Learning Results

Contidos
Topic

Planificación			
	Class hours	Hours outside the classroom	Total hours
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Metodoloxía docente	
	Description

Atención personalizada

Avaliación		
Description	Qualification	Training and Learning Results

Other comments on the Evaluation

Bibliografía. Fontes de información
Basic Bibliography
Complementary Bibliography

Recomendacións

IDENTIFYING DATA				
(*)Despregamento de rede para aplicacións de Smart Cities/Buildings				
Subject	(*)Despregamento de rede para aplicacións de Smart Cities/Buildings			
Code	V05M200V01210			
Study programme	(*)Máster Universitario en Internet das Cousas- IoT			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Optional	1st	2nd
Teaching language	#EnglishFriendly			
Department				
Coordinator	Vazquez Alejos, Ana Rubiños López, José Óscar Arias Acuña, Alberto Marcos			
Lecturers	Arias Acuña, Alberto Marcos Rubiños López, José Óscar Vazquez Alejos, Ana			
E-mail	marcos@com.uvigo.es analejos@uvigo.es oscar@com.uvigo.es			
Web	http://moovi.uvigo.gal			
General description	This subject provides comprehensive training on the deployment of networks for IoT applications in smart urban environments and connected vehicles. Upon completing the course, students will develop key skills in the design and implementation of wireless communication systems, both for urban environments (Smart Cities and Smart Buildings) and for connected vehicle applications (Smart Car). Students will learn to understand and apply fundamental concepts of radio link capacity and coverage, radio propagation modeling, and network implementation. In addition, they will delve into wireless mobile communications standards for urban and vehicular applications, providing a solid foundation for the practical implementation of these systems. Students will also acquire the skills to perform practical deployments and validate measurements, as well as prepare technical reports and oral presentations. The content of the course includes an introduction to communications in Smart Cities, Smart Buildings and Smart Car use cases, theoretical-practical analysis of use cases, study of radio channels for different scopes and analysis of capacity subsystems and hardware subsystems. ... Aspects related to radio certification of communications in these environments and the monitoring of key performance indicators (KPIs), as well as the quality of the user experience, will also be addressed. The subject responds to the growing demand for knowledge in the field of IoT and 5G/6G technology, preparing students to contribute to the development of Society 5.0 through the deployment of advanced networks in urban and vehicular environments.			

Training and Learning Results	
Code	
B20	S-CN8: Know and understand the concepts and systems related to the deployment of networks in the field of applications for Society 5.0.
B32	V-CN6: Knowing and understanding the basic concepts related with the deployment of networks in the connected vehicle environment.
D14	S-CP1: Design and deploy networks of IoT devices in the field of Smart Cities and Buildings.
D23	V-CP1: Design and deploy device networks in the connected car domain.

Expected results from this subject	
Expected results from this subject	Training and Learning Results
Comprise and apply the mechanisms of propagation of radius and digital transmission, as well as the concepts of channel irradiate, coverage and capacity of a radiolink or system of broadcast for the modelling and deployment of wireless networks in applications of Smart City, Smart Building or Smart Car.	B20 B32
Understand the operation of the main hardware sub-systems (antennas, transmitters, receptors) and apply them in the design and deployment of networks.	B20 B32 D14 D23

Analyse and manage radioelectrical interferences, as well as understand the principles of attribution, adjudication and allocation of frequencies.	D14 D23
Design and evaluate networks of devices in intelligent urban and connected vehicles surroundings, according to the standards and wireless and mobile communications technologies.	D14 D23
Make practical network deployments, including the validation of measurements, preparation of technical reports and oral presentations, and evaluate the social impact, economic and environmental of the networks developed.	B20 B32 D14 D23

Contents
Topic
Unit 1. Introduction to urban and vehicular communications.
Unit 2. Elements of a communication network.
Unit 3. Propagation modeling: Study of the radio channel. Coverage and capacity analysis.
Unit 4. Network monitoring. Radio certification.
Unit 5. Theoretical-practical analysis of the use case.
Practice 1. Propagation models: simulation and experimental measurement.
Practice 2. LIDAR/RADAR systems. (Smart Car) Practice 2. Indoor LoRA network for urban communications. (Smart Cities / Buildings)
Practice 3. Outdoor LoRA network for urban and vehicular communications. (Smart Car / Cities / Buildings)
Practice 4. GPS reckoning for vehicular communications. (Smart Car) Practice 4. Indoor LTE / NB-IoT network. (Smart Cities/Buildings)
Practice 5. LTE / NB-IoT network for urban and vehicular communications.
Practice 6. Project: Car with LoRa (Smart Car) LoRA tracker indoor/outdoor (Smart Cities/Buildings)

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	9	9	18
Problem solving	1.5	2	3.5
Case studies	1.5	2	3.5
Laboratory practical	10	10	20
Mentored work	2	6	8
Essay questions exam	1.5	5.5	7
Laboratory practice	0	5	5
Presentation	1	2	3
Essay questions exam	1.5	5.5	7

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies

	Description
Lecturing	Presentation of the theoretical contents of the subject by teachers.
Problem solving	The theoretical contents covered in the master classes will be complemented with problem solving and/or exercises in the classroom.
Case studies	In the master classes, practical cases will be carried out in the classroom.
Laboratory practical	e carrying out of practical cases in the laboratory will be proposed, in a practical format with the delivery of an evaluable report/report.
Mentored work	The development of a work, individual or in group, will be proposed that covers some of the topics considered in the master classes and laboratory practices, with delivery of a report and oral presentation of results.

Personalized assistance	
Methodologies	**Description**
Lecturing	The students will be able to consult any doubt during this time of classes. If necessary, an appointment for tutoring with the faculty must be scheduled through the contact information provided in Moovi and the following links: Marcos Arias Acuña @ https://www.uvigo.gal/es/universidad/administracion-personal/pdi/alberto-marcos-arias-acuna Oscar Rubiños López @ https://www.uvigo.gal/es/universidad/administracion-personal/pdi/jose-oscar-rubinos-lopez
Laboratory practical	The lecturer will be available during the completion of the proposed practices to attend and resolve doubts. If necessary, an appointment for tutoring with the faculty must be scheduled through the contact information provided in Moovi and the following link: Ana Vázquez Alejos @ https://www.uvigo.gal/universidade/administracion-persoal/pdi/ana-vazquez-alejos
Problem solving	The resolution of problems and exercises is carried out during face-to-face hours and the students will be able to consult any doubt during this time of classes. If necessary, an appointment for tutoring with the faculty must be scheduled through the contact information provided in Moovi and the following links: Marcos Arias Acuña @ https://www.uvigo.gal/es/universidad/administracion-personal/pdi/alberto-marcos-arias-acuna Oscar Rubiños López @ https://www.uvigo.gal/es/universidad/administracion-personal/pdi/jose-oscar-rubinos-lopez
Case studies	The case study is carried out during face-to-face hours and the students will be able to consult any doubt during this time of classes. If necessary, an appointment for tutoring with the faculty must be scheduled through the contact information provided in Moovi and the following links: Marcos Arias Acuña @ https://www.uvigo.gal/es/universidad/administracion-personal/pdi/alberto-marcos-arias-acuna Oscar Rubiños López @ https://www.uvigo.gal/es/universidad/administracion-personal/pdi/jose-oscar-rubinos-lopez
Mentored work	The students will be able to consult any doubt during this time of classes. If necessary, an appointment for tutoring with the faculty must be scheduled through the contact information provided in Moovi and the following link: Ana Vázquez Alejos @ https://www.uvigo.gal/universidade/administracion-persoal/pdi/ana-vazquez-alejos
Tests	**Description**
Presentation	To resolve doubts related to the presentation of mentored work, an appointment for tutoring with the faculty must be scheduled through the contact information provided in Moovi and the following link: Ana Vázquez Alejos @ https://www.uvigo.gal/universidade/administracion-persoal/pdi/ana-vazquez-alejos
Essay questions exam	To resolve doubts related to this test, an appointment for tutoring with the faculty must be scheduled through the contact information provided in Moovi and the following links: Marcos Arias Acuña @ https://www.uvigo.gal/es/universidad/administracion-personal/pdi/alberto-marcos-arias-acuna Oscar Rubiños López @ https://www.uvigo.gal/es/universidad/administracion-personal/pdi/jose-oscar-rubinos-lopez
Essay questions exam	To resolve doubts related to this test, an appointment for tutoring with the faculty must be scheduled through the contact information provided in Moovi and the following links: Marcos Arias Acuña @ https://www.uvigo.gal/es/universidad/administracion-personal/pdi/alberto-marcos-arias-acuna Oscar Rubiños López @ https://www.uvigo.gal/es/universidad/administracion-personal/pdi/jose-oscar-rubinos-lopez
Laboratory practice	For the delivery and assessment of the memory of the practices an appointment for tutoring with the faculty must be scheduled through the contact information provided in Moovi and the following link: Ana Vázquez Alejos @ https://www.uvigo.gal/universidade/administracion-persoal/pdi/ana-vazquez-alejos

Assessment				
	Description	Qualification	Training and Learning Results	
Essay questions exam	Exam to solve short exercises focused to Units 1 and 2.	25	B20 B32	
Laboratory practice	For each laboratroy practice, a report of results will be presented individually.	30		D14 D23
Presentation	Oral presentation, individual or group, of the supervised work. The evaluation of each member of the group will be done through personalized monitoring.	15	B20 B32	D14 D23
Essay questions exam	Exam to solve short exercises focused to Units 3, 4 and 5.	30	B20 B32	D14 D23

Other comments on the Evaluation
Students enrolled in the subject can choose one of the two proposed assessment systems: continuous assessment or exam-

only assessment. Each student must notify the coordinating professor by email of the selected assessment system one month after the start of classes.

Continuous assessment (ordinary exam)

Continuous assessment involves performing throughout the semester of the paragraphs disaggregated in the above table. Each of the blocks is of mandatory fulfillment in the form of continuous and individual assessment, and to pass the subject a minimum of 25% of the note assigned to each of the sections and the total mark accumulated within the five sections to be achieved must overcome at least 50% of the final grade.

The essay questions exams consist of a reasoned resolution of exercises on the subject topics. Regarding the block of laboratory practices, one report is required per practice and per student, made in a individual way. Evidences of report copying or cloning will drive to fail the related task.

Continuous assessment involves making 100% of all proposed tasks. Failure to take any of these tests implies the loss of continuous assessment and the final grade will be "SUSPENSO".

These tasks are not recoverable, that is, if a student does not satisfy the scheduled tasks, the teacher has no obligation to repeat any of them, and also they will be only valid for the academic year in which they are completed.

The schedule of the midterm/intermediate exams will be approved in the Comisión Académica de Máster (CAM) and will be available at the beginning of each academic semester.

It is considered that the subject is passed if the total grade is equal to or greater than 5. In case of leaving the modality of continuous assessment, the final grade will be "SUSPENSO".

Exam-only assessment (ordinary exam)

A student who does not opt for continuous assessment should be eligible for the highest grade by a final exam, which will consist of two parts:

- Part 1: realization of laboratory practices and delivery of reports due (50% of the final grade). One report is required per practice and per student, made in a individual way. Evidences of report copying or cloning will drive to grade as zero the related practice.

- Part 2: problem solving exam (50% of the final grade).

It is considered that the subject is passed by eventual assessment if the total grade is equal to or greater than 5.

Extraordinary exam

For students who chose the exam-only assessment, the grade will be given by a final exam that will consist of two parts: a practical examination (50%) and an examination of problems (50%) .

It is considered that the subject is approved in second call if the total grade is equal to or greater than 5.

End-of-program exam

It will consist of an exam with three parts: a practical examination (40%) and an examination of problems (60%). It is considered that the subject is approved if the total grade is equal to or greater than 5.

Ethical code and plagiarism

Plagiarism is regarded as serious dishonest behavior. If any form of plagiarism is detected in any of the tests or exams, the final grade will be FAIL (0), and the incident will be reported to the corresponding academic authorities for prosecution.

An ethical and critical use of tools based on artificial intelligence is recommended, and it is advisable to indicate their use in the reports delivered.

Sources of information
Basic Bibliography
Marcos Arias Acuña, Oscar Rubiños López, **Radiocomunicación**, 978-84-8408-603-1, Andavira Editoria, 2011
Ana Vázquez Alejos, **Guía de prácticas de laboratorio**,
Rolando Herrero, **Fundamentals of IoT communication technologies**, 978-3-030-70079-9, Cham : Springer, 2022
R. Buyya, A. V. Dastjerdi, **Internet of Things: Principles and paradigms**, 978-0-12-805395-9, Elsevier, 2016
Oriol Sallent, **Fundamentos de diseño y gestión de sistemas de comunicaciones móviles celulares**, 978-8-49-880482-9, Iniciativa Digital Politècnica, 2014

Complementary Bibliography

W. Dargie, C. Poellabauer, **Fundamentals of Wireless Sensor Networks: Theory and Practice**, 978-0-47-099765-9, Wiley, 2010

Leyre Azpilicueta, Cesar Vargas-Rosales, Francisco Falcone, Ana Alejos, **Radio Wave Propagation in Vehicular Environments**, 978-1-78561-823-9, Institution of Engineering and Technology (IET), 2020

Andreas F. Molisch, **Wireless Communications: From Fundamentals to Beyond 5G, 3rd Edition**, 978-1-119-11721-6, Wiley, 2022

Recommendations

Subjects that continue the syllabus

(*)Dispositivos IoT/V05M200V01101

IDENTIFYING DATA				
Integración de sistemas en IIoT				
Subject	Integración de sistemas en IIoT			
Code	V05M200V01211			
Study programme	Máster Universitario en Internet das Cousas- IoT			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Optional	1	2c
Teaching language				
Department				
Coordinator	López Ardao, José Carlos			
Lecturers				
E-mail				
Web	http://https://guiadocente.udc.es/guia_docent/index.php?centre=614&ensenyament=614557&assignatura=614557011&any_academic=2024_25&idioma=cast&any_academic=2024_25			
General description	Materia coordinada pola UDC. A guía docente está dispoñible no enlace indicado arriba			

Resultados de Formación e Aprendizaxe	
Code	

Resultados previstos na materia	
Expected results from this subject	Training and Learning Results

Contidos
Topic

Planificación			
	Class hours	Hours outside the classroom	Total hours

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Metodoloxía docente	
	Description

Atención personalizada

Avaliación		
Description	Qualification	Training and Learning Results

Other comments on the Evaluation

Bibliografía. Fontes de información
Basic Bibliography
Complementary Bibliography

Recomendacións

IDENTIFYING DATA				
Green IoT				
Subject	Green IoT			
Code	V05M200V01212			
Study programme	Máster Universitario en Internet das Cousas- IoT			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Optional	1	2c
Teaching language				
Department				
Coordinator	López Ardao, José Carlos			
Lecturers				
E-mail				
Web	http://https://guiadocente.udc.es/guia_docent/index.php?centre=614&ensenyament=614557&assignatura=614557012&any_academic=2024_25&idioma=cast&any_academic=2024_25			
General description	Materia coordinada pola UDC. A guía docente está dispoñible no enlace indicado arriba			

Resultados de Formación e Aprendizaxe
Code

Resultados previstos na materia	
Expected results from this subject	Training and Learning Results

Contidos
Topic

Planificación			
	Class hours	Hours outside the classroom	Total hours
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Metodoloxía docente	
	Description

Atención personalizada

Avaliación		
Description	Qualification	Training and Learning Results

Other comments on the Evaluation

Bibliografía. Fontes de información
Basic Bibliography
Complementary Bibliography

Recomendacións

IDENTIFYING DATA				
Xemelgos dixitais para plantas industriais				
Subject	Xemelgos dixitais para plantas industriais			
Code	V05M200V01213			
Study programme	Máster Universitario en Internet das Cousas- IoT			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Optional	1	2c
Teaching language	Castelán			
Department	Enxeñaría de sistemas e automática			
Coordinator	Garrido Campos, Julio			
Lecturers	Garrido Campos, Julio			
E-mail	jgarri@uvigo.es			
Web	http://https://www.usc.gal/es/plan/19398/course/75/subject/19781-18875-3-103896			
General description	Materia coordinada pola USC. A guía docente está dispoñible no enlace indicado arriba			

Resultados de Formación e Aprendizaxe
Code

Resultados previstos na materia	
Expected results from this subject	Training and Learning Results

Contidos	
Topic	
Tema 1:Arquitecturas IIoT para simulación, supervisión e xemelgos dixitais industriais.	1.1. Arquitecturas estándar de Xemelgos dixitais industriais en maquinaria robóticaa. 1.2. IIoT en contornas de xemelgos dixitais industriais: sistemas continuos robóticos 1.3. Requisitos para a explotación remota de datos industriais. 1.4. IIoT para sistemas de Supervisión e Mando.
Tema 2. Implementacións en controlador industrial de arquitecturas IIoT	2.1. Protocolos IIoT específicos para sistemas robóticos. 2.2. Implementación en prototipo real. 2.3. Implementación con requisitos temporais esixentes e/o volumen de datos elevado.

Planificación			
	Class hours	Hours outside the classroom	Total hours
Lección maxistral	12	12	24
Prácticas de laboratorio	12	12	24
Traballo tutelado	0	12	12
Exame de preguntas de desenvolvemento	1	14	15
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Metodoloxía docente	
	Description
Lección maxistral	Clases de aula apoyadas en material documental suministrado polo profesor.
Prácticas de laboratorio	Exercicios prácticos de programación. Presentacións demostrativas por parte do profesor
Traballo tutelado	Desenvolvementos de software baseados no explicado nas clases maxistrais e prácticas de laboratorio

Atención personalizada	
Methodologies	**Description**
Lección maxistral	Se o alumno/para necesita aclaración adicional á das clases teóricas ou prácticas, terá titorías dispoñibles para resolver as dúbidas. A atención poderá ser tanto presencial como en liña.

Prácticas de laboratorio	Se o alumno/para necesita aclaración adicional á das clases teóricas ou prácticas, terá titorías dispoñibles para resolver as dúbidas. A atención poderá ser tanto presencial como en liña.

Tests	**Description**
Exame de preguntas de desenvolvemento	Se o alumno/para necesita aclaración adicional á das clases teóricas ou prácticas, terá titorías dispoñibles para resolver as dúbidas. A atención poderá ser tanto presencial como en liña.

Avaliación

	Description	Qualification	Training and Learning Results
Prácticas de laboratorio	Resultados de las prácticas de laboratorio	30	
Traballo tutelado	Trabajo individual	30	
Exame de preguntas de desenvolvemento	Examen sobre todos los contenidos del curso	40	

Other comments on the Evaluation

Bibliografía. Fontes de información

Basic Bibliography

Barrientos, Peñín, Balaguer y Aracil,, **Fundamentos de Robótica**, 978-8448156367, McGraw-Hill, 2009

Complementary Bibliography

ISO, **ISO 23247-4:2021: Automation systems and integration Digital twin framework for manufacturing**, ISO,

UE, **Directiva de máquinas 2006/42/ec**, UE,

Recomendacións

Other comments

O alumno debería dispoñer dun computador con capacidade para instalar a Máquina Virtual que será proporcionada polos docentes.

IDENTIFYING DATA				
(*)Xemelgos dixitais robóticos				
Subject	(*)Xemelgos dixitais robóticos			
Code	V05M200V01214			
Study programme	(*)Máster Universitario en Internet das Cousas- IoT			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Optional	1st	2nd
Teaching language				
Department				
Coordinator	Garrido Campos, Julio			
Lecturers	Garrido Campos, Julio			
E-mail	jgarri@uvigo.es			
Web				
General description	The course introduces students to the principles of design, development and implementation of digital twins in industrial robotic environments. The principles of operation of industrial systems with motion control (robots, machining systems, automatic systems for handling and transporting parts) are presented. The operating principles of the target systems, their control and communication architectures and the significant operating variables for the development of digital twins of the same are analysed. The relevant standards involved are also analysed in order to generalise the development of this type of digital twin and access to its variables.			

Training and Learning Results
Code

Expected results from this subject	
Expected results from this subject	Training and Learning Results

Contents
Topic
□ Requirements for remote exploitation of industrial data. □ IIoT for Supervisory Control and Monitoring systems. □ IIoT in industrial digital twin environments: continuous robotic systems. □ Standard Industrial Digital Twin architectures in robotic machinery. □ Industrial controller implementations of IIoT architectures. □ Specific IIoT protocols for robotic systems. □ Standard digital twin architectures for robotic systems. □ Real prototype implementation. □ Implementation with demanding time requirements and high data volume.

(*) Arquitecturas IIoT para simulación, supervisión e xemelgos dixitais industriais.
 Requisitos para a explotación remota de datos industriais.
 IIoT para sistemas de Supervisión e Mando.
 IIoT en contornas de xemelgos dixitais industriais: sistemas continuos robóticos.
 Arquitecturas estándar de Xemelgos dixitais industriais en maquinaria robótica.
 Implementacións en controlador industrial de arquitecturas IIoT.
 Protocolos IIoT específicos para sistemas robóticos.
 Arquitecturas estándar de Xemelgo dixital de sistema robótico.
 Implementación en prototipo real.
 Implementación con requisitos temporais esixentes e volume de datos elevado.

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	12	24	36
Practices through ICT	12	12	24
Mentored work	0	13	13
Essay questions exam	2	0	2

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies	
	Description
Lecturing	They will consist in the explanation of the different sections of the program of the subject.
Practices through ICT	They will pose different practical problems related with the content of the subject so that the student resolve of individual form or in groups.
Mentored work	Cases of use and/or practical problems that require autonomous work by part of students, although with the supervision of the teaching staff

Personalized assistance	
Methodologies	**Description**
Practices through ICT	Tutorial sessions will serve to resolve the doubts of the students related with the practices of the subject. These sessions will be so much face-to-face like virtual through email, virtual campus or platform of videoconference. The synchronous sessions will require previous appointment.
Lecturing	Tutorial sessions will serve to resolve the doubts of the students related with the contents of the subject. These sessions will be so much face-to-face like virtual through email, virtual campus or platform of videoconference. The synchronous sessions will require previous appointment.
Mentored work	Tutorial sessions will serve to resolve the doubts of the students related with the mentored work. These sessions will be so much face-to-face like virtual through email, virtual campus or platform of videoconference. The synchronous sessions will require previous appointment.

Assessment		
	DescriptionQualification	Training and Learning Results
Practices through ICT	30	
Mentored work	30	
Essay questions exam	40	

Other comments on the Evaluation

The subject is passed with a 5 and it is necessary to pass each part separately with at least 40% of the evaluation of each of them.

Second opportunity

The evaluation obtained in the practical work (practical and supervised work) during the course is maintained, as well as its weight in the final evaluation. Students who have not achieved the cut-off mark in the activities proposed during the previous call may submit, prior to the second chance final exam, activities similar to those not passed, which will be

proposed by the teachers. Once both parts have been passed separately, the exam will account for 40% of the final mark and the practicals for the remaining 60%. The subject is passed with a 5 and it is necessary to pass each part separately with at least 40% of the evaluation of each of them.

Sources of information
Basic Bibliography
Barrientos, Peñín, Balaguer y Aracil, **Fundamentos de Robótica**, 978-8448156367, McGraw-Hill,
Complementary Bibliography
ISO 23247-4:2021: Automation systems and integration Digital twin framework for manufacturing Estándar,
Standard IEC Motion Control,
Directiva de máquinas 2006/42/ec,

Recommendations

Other comments

The student should have a computer with the capacity to install the Virtual Machine that will be provided by the professors

IDENTIFYING DATA				
Análise de video en IIoT				
Subject	Análise de video en IIoT			
Code	V05M200V01215			
Study programme	Máster Universitario en Internet das Cousas- IoT			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Optional	1	2c
Teaching language				
Department				
Coordinator	López Ardao, José Carlos			
Lecturers				
E-mail				
Web	http://https://www.usc.gal/es/plan/19398/course/75/subject/19781-18875-3-106200			
General description	Materia coordinada pola USC. A guía docente está dispoñible no enlace indicado arriba			

Resultados de Formación e Aprendizaxe	
Code	

Resultados previstos na materia	
Expected results from this subject	Training and Learning Results

Contidos
Topic

Planificación			
	Class hours	Hours outside the classroom	Total hours
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Metodoloxía docente	
	Description

Atención personalizada

Avaliación		
Description	Qualification	Training and Learning Results

Other comments on the Evaluation

Bibliografía. Fontes de información
Basic Bibliography
Complementary Bibliography

Recomendacións

IDENTIFYING DATA				
Big Data para IIoT				
Subject	Big Data para IIoT			
Code	V05M200V01216			
Study programme	Máster Universitario en Internet das Cousas- IoT			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Optional	1	2c
Teaching language				
Department				
Coordinator	López Ardao, José Carlos			
Lecturers				
E-mail				
Web	http://https://www.usc.gal/es/plan/19398/course/75/subject/19781-18875-3-106201			
General description	Materia coordinada pola USC. A guía docente está dispoñible no enlace indicado arriba			

Resultados de Formación e Aprendizaxe
Code

Resultados previstos na materia	
Expected results from this subject	Training and Learning Results

Contidos
Topic

Planificación			
	Class hours	Hours outside the classroom	Total hours
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Metodoloxía docente	
	Description

Atención personalizada

Avaliación		
Description	Qualification	Training and Learning Results

Other comments on the Evaluation

Bibliografía. Fontes de información
Basic Bibliography
Complementary Bibliography

Recomendacións

IDENTIFYING DATA				
(*)IoT no ámbito do vehículo conectado				
Subject	(*)IoT no ámbito do vehículo conectado			
Code	V05M200V01217			
Study programme	(*)Máster Universitario en Internet das Cousas- IoT			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Optional	1st	2nd
Teaching language	Spanish Galician			
Department				
Coordinator	Gil Castiñeira, Felipe José			
Lecturers	Gil Castiñeira, Felipe José			
E-mail	xil@gti.uvigo.es			
Web	http://teleco.uvigo.es/es/estudos/mestrados/master-universitario-en-internet-de-las-cosas-iot-muiot/			
General description	The automotive industry is rapidly evolving with software-defined cars, next-generation electric vehicles, and autonomous vehicles powered by powerful processors and new mobility services. European legislation, such as eCall, and growing customer interest in digital features are accelerating these changes. It is estimated that next year there will be 470 million connected vehicles on the road. It is essential to understand the hardware and software architectures that enable these functionalities, as well as the communication systems that make the vehicle an IoT system.			

Training and Learning Results	
Code	
B30	V-CN4: Know and understand the architecture of the connected and autonomous vehicle and its main elements.
D28	V-CP6: Design and deploy services for the connected vehicle.

Expected results from this subject	Training and Learning Results
V-CN4:Know and understand the architecture of the connected and autonomous vehicle and its main elements.	B30
V-CP6: Design and deploy services for the connected vehicle.	D28

Contents	
Topic	
Introduction: architecture of the connected vehicle.	- Concepts - Regulations - Connected vehicle and autonomous vehicle - Architecture layers (devices, connectivity, data models, operations, applications, security, etc.)
Embedded hardware and software.	- Telematics Control Unit (TCU) - Sensors - Networks and communication buses in the vehicle - Software architectures and operating systems - Applications
Communication systems.	- V2X (Vehicle-to-Everything) - Communications with the cloud (cellular, satellite, etc.) - Integration with user devices (Bluetooth, Wi-Fi, etc.)
Use cases of the connected vehicle and the autonomous vehicle.	- Emergencies - ADAS (Advanced Driver Assistance Systems) - Diagnostics - Updates - Connected services - Fleet management - Etc.

Planning	Class hours	Hours outside the classroom	Total hours
Lecturing	12	12	24

Project based learning	12	36	48
Objective questions exam	2	0	2
Presentation	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

	Description
Lecturing	Presentation of the main contents of the subject.
Project based learning	Development of a practical IoT project in the field of connected vehicles.

Personalized assistance

Methodologies	Description
Lecturing	The faculty of the subject will provide individual and personalized attention to students throughout the course, addressing their doubts and questions. Doubts will be addressed during the lectures themselves or during the scheduled tutoring hours. The tutoring schedule can be consulted or requested on the subject's webpage.
Project based learning	The faculty of the subject will provide individualized and personalized attention to students throughout the course, addressing their doubts and questions. Additionally, the faculty will guide and support students during the project implementation. Doubts will be addressed during the face-to-face sessions or during the designated tutoring hours. The tutoring schedule can be consulted or requested on the subject's webpage.

Assessment

	Description	Qualification	Training and Learning Results
Lecturing	There will be one or more exams to assess the understanding of the content presented in the lectures. If there are multiple exams, the final grade will be the arithmetic mean of the different tests.	40	
Project based learning	Students will design, implement, and test a protocol, system, application, or service. The outcome will be evaluated after submission, considering aspects such as correctness, quality, performance, and functionality. Additionally, there will be ongoing monitoring of the design and implementation progress throughout the project. If interim results are unsatisfactory, a penalty of up to 20% of the grade may be applied. Monitoring may be conducted in groups if the faculty decides to assign group projects, but evaluation will always be individual. Each student must document their tasks individually and be prepared to discuss them.	40	
Presentation	The students will present the results of their project by conducting a practical demonstration of their work.	20	

Other comments on the Evaluation

Sources of information

Basic Bibliography

Dominique Paret, **Autonomous and Connected Vehicles: Network Architectures from Legacy Networks to Automotive Ethernet**, 1119816122, 1, Wiley, 2022

Complementary Bibliography

Gurinder Singh, Vishal Jain, Jyotir Moy Chatterjee, Loveleen Gaur, **Cloud and IoT-Based Vehicular Ad Hoc Networks**, 1119761832, 1, Wiley-Scrivener, 2021

Yunpeng Wang, Daxin Tian, Zhengguo Sheng, Wang Jian, **Connected Vehicle Systems: Communication, Data, and Control**, 1138035874, 1, CRC Press, 2017

Umar Zakir Abdul Hamid, **Autonomous, Connected, Electric and Shared Vehicles: Disrupting the Automotive and Mobility Sectors**, 1468603477, 1, SAE International, 2022

Recommendations

Subjects that are recommended to be taken simultaneously

(*)Big Data para o vehículo conectado/V05M200V01220
(*)Despregamento de rede para aplicacións de Smart Car/V05M200V01221
(*)Sistemas de transporte intelixente/V05M200V01218

IDENTIFYING DATA				
Sistemas de transporte intelixente				
Subject	Sistemas de transporte intelixente			
Code	V05M200V01218			
Study programme	Máster Universitario en Internet das Cousas- IoT			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Optional	1	2c
Teaching language				
Department				
Coordinator	López Ardao, José Carlos			
Lecturers				
E-mail				
Web	http://https://guiadocente.udc.es/guia_docent/index.php?centre=614&ensenyament=614557&assignatura=614557024&any_academic=2024_25&idioma=cast&any_academic=2024_25			
General description	Materia coordinada pola UDC. A guía docente está dispoñible no enlace indicado arriba			

Resultados de Formación e Aprendizaxe
Code

Resultados previstos na materia	
Expected results from this subject	Training and Learning Results

Contidos
Topic

Planificación			
	Class hours	Hours outside the classroom	Total hours
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Metodoloxía docente	
	Description

Atención personalizada

Avaliación		
Description	Qualification	Training and Learning Results

Other comments on the Evaluation

Bibliografía. Fontes de información
Basic Bibliography
Complementary Bibliography

Recomendacións

IDENTIFYING DATA				
IoT para UAVs				
Subject	IoT para UAVs			
Code	V05M200V01219			
Study programme	Máster Universitario en Internet das Cousas- IoT			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Optional	1	2c
Teaching language				
Department				
Coordinator	Gil Castiñeira, Felipe José			
Lecturers	Gil Castiñeira, Felipe José			
E-mail	xil@gti.uvigo.es			
Web	http://https://guiadocente.udc.es/guia_docent/index.php?centre=614&ensenyament=614557&assignatura=614557025&any_academic=2024_25&idioma=cast&any_academic=2024_25			
General description	Materia coordinada pola UDC. A guía docente está dispoñible no enlace indicado arriba			

Resultados de Formación e Aprendizaxe
Code

Resultados previstos na materia	
Expected results from this subject	Training and Learning Results

Contidos
Topic

Planificación			
	Class hours	Hours outside the classroom	Total hours
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Metodoloxía docente	
	Description

Atención personalizada

Avaliación		
Description	Qualification	Training and Learning Results

Other comments on the Evaluation

Bibliografía. Fontes de información
Basic Bibliography
Complementary Bibliography

Recomendacións

IDENTIFYING DATA				
Big Data para o vehículo conectado				
Subject	Big Data para o vehículo conectado			
Code	V05M200V01220			
Study programme	Máster Universitario en Internet das Cousas- IoT			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Optional	1	2c
Teaching language				
Department				
Coordinator	López Ardao, José Carlos			
Lecturers				
E-mail				
Web	http://https://www.usc.gal/es/plan/19398/course/75/subject/19401-18495-3-103903			
General description	Materia coordinada pola USC. A guía docente está dispoñible no enlace indicado arriba			

Resultados de Formación e Aprendizaxe
Code

Resultados previstos na materia	
Expected results from this subject	Training and Learning Results

Contidos
Topic

Planificación			
	Class hours	Hours outside the classroom	Total hours
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Metodoloxía docente	
	Description

Atención personalizada

Avaliación		
Description	Qualification	Training and Learning Results

Other comments on the Evaluation

Bibliografía. Fontes de información
Basic Bibliography
Complementary Bibliography

Recomendacións

IDENTIFYING DATA				
(*)Despregamento de rede para aplicacións de Smart Car				
Subject	(*)Despregamento de rede para aplicacións de Smart Car			
Code	V05M200V01221			
Study programme	(*)Máster Universitario en Internet das Cousas- IoT			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Optional	1st	2nd
Teaching language	#EnglishFriendly			
Department				
Coordinator	Vazquez Alejos, Ana			
Lecturers				
E-mail				
Web	http://moovi.uvigo.gal			
General description	This subject provides comprehensive training on the deployment of networks for IoT applications in smart urban environments and connected vehicles. Upon completing the course, students will develop key skills in the design and implementation of wireless communication systems, both for urban environments (Smart Cities and Smart Buildings) and for connected vehicle applications (Smart Car). Students will learn to understand and apply fundamental concepts of radio link capacity and coverage, radio propagation modeling, and network implementation. In addition, they will delve into wireless mobile communications standards for urban and vehicular applications, providing a solid foundation for the practical implementation of these systems. Students will also acquire the skills to perform practical deployments and validate measurements, as well as prepare technical reports and oral presentations. The content of the course includes an introduction to communications in Smart Cities, Smart Buildings and Smart Car use cases, theoretical-practical analysis of use cases, study of radio channels for different scopes and analysis of capacity subsystems and hardware subsystems. ... Aspects related to radio certification of communications in these environments and the monitoring of key performance indicators (KPIs), as well as the quality of the user experience, will also be addressed. The subject responds to the growing demand for knowledge in the field of IoT and 5G/6G technology, preparing students to contribute to the development of Society 5.0 through the deployment of advanced networks in urban and vehicular environments.			

Training and Learning Results	
Code	
B20	S-CN8: Know and understand the concepts and systems related to the deployment of networks in the field of applications for Society 5.0.
B32	V-CN6: Knowing and understanding the basic concepts related with the deployment of networks in the connected vehicle environment.
D14	S-CP1: Design and deploy networks of IoT devices in the field of Smart Cities and Buildings.
D23	V-CP1: Design and deploy device networks in the connected car domain.

Expected results from this subject	
Expected results from this subject	Training and Learning Results
Comprise and apply the mechanisms of propagation of radius and digital transmission, as well as the concepts of channel irradiate, coverage and capacity of a radiolink or system of broadcast for the modelling and deployment of wireless networks in applications of Smart City, Smart Building or Smart Car.	B20 B32
Understand the operation of the main hardware sub-systems (antennas, transmitters, receptors) and apply them in the design and deployment of networks.	B20 B32 D14 D23
Analyse and manage radioelectrical interferences, as well as understand the principles of attribution, adjudication and allocation of frequencies.	D14 D23
Design and evaluate networks of devices in intelligent urban and connected vehicles surroundings, according to the standards and wireless and mobile communications technologies.	D14 D23

Make practical network deployments, including the validation of measurements, preparation of technical reports and oral presentations, and evaluate the social impact, economic and environmental of the networks developed.	B20 B32 D14 D23

Contents
Topic
Unit 1. Introduction to urban and vehicular communications.
Unit 2. Elements of a communication network.
Unit 3. Propagation modeling: Study of the radio channel. Coverage and capacity analysis.
Unit 4. Network monitoring. Radio certification.
Unit 5. Theoretical-practical analysis of the use case.
Practice 1. Propagation models: simulation and experimental measurement.
Practice 2. LIDAR/RADAR systems. (Smart Car) Practice 2. Indoor LoRA network for urban communications. (Smart Cities / Buildings)
Practice 3. Outdoor LoRA network for urban and vehicular communications. (Smart Car / Cities / Buildings)
Practice 4. GPS reckoning for vehicular communications. (Smart Car) Practice 4. Indoor LTE / NB-IoT network. (Smart Cities/Buildings)
Practice 5. LTE / NB-IoT network for urban and vehicular communications.
Practice 6. Project: Car with LoRa (Smart Car) LoRA tracker indoor/outdoor (Smart Cities/Buildings)

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	9	9	18
Problem solving	1.5	2	3.5
Case studies	1.5	2	3.5
Laboratory practical	10	10	20
Mentored work	2	6	8
Essay questions exam	1.5	5.5	7
Laboratory practice	0	5	5
Presentation	1	2	3
Essay questions exam	1.5	5.5	7
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Lecturing	Presentation of the theoretical contents of the subject by teachers.
Problem solving	The theoretical contents covered in the master classes will be complemented with problem solving and/or exercises in the classroom.
Case studies	In the master classes, practical cases will be carried out in the classroom.
Laboratory practical	e carrying out of practical cases in the laboratory will be proposed, in a practical format with the delivery of an evaluable report/report.
Mentored work	The development of a work, individual or in group, will be proposed that covers some of the topics considered in the master classes and laboratory practices, with delivery of a report and oral presentation of results.

Personalized assistance	
Methodologies	**Description**

Lecturing	The students will be able to consult any doubt during this time of classes. If necessary, an appointment for tutoring with the faculty must be scheduled through the contact information provided in Moovi and the following links: Marcos Arias Acuña @ https://www.uvigo.gal/es/universidad/administracion-personal/pdi/alberto-marcos-arias-acuna Oscar Rubiños López @ https://www.uvigo.gal/es/universidad/administracion-personal/pdi/jose-oscar-rubinos-lopez
Laboratory practical	The lecturer will be available during the completion of the proposed practices to attend and resolve doubts. If necessary, an appointment for tutoring with the faculty must be scheduled through the contact information provided in Moovi and the following link: Ana Vázquez Alejos @ https://www.uvigo.gal/universidade/administracion-persoal/pdi/ana-vazquez-alejos
Problem solving	The resolution of problems and exercises is carried out during face-to-face hours and the students will be able to consult any doubt during this time of classes. If necessary, an appointment for tutoring with the faculty must be scheduled through the contact information provided in Moovi and the following links: Marcos Arias Acuña @ https://www.uvigo.gal/es/universidad/administracion-personal/pdi/alberto-marcos-arias-acuna Oscar Rubiños López @ https://www.uvigo.gal/es/universidad/administracion-personal/pdi/jose-oscar-rubinos-lopez
Case studies	The case study is carried out during face-to-face hours and the students will be able to consult any doubt during this time of classes. If necessary, an appointment for tutoring with the faculty must be scheduled through the contact information provided in Moovi and the following links: Marcos Arias Acuña @ https://www.uvigo.gal/es/universidad/administracion-personal/pdi/alberto-marcos-arias-acuna Oscar Rubiños López @ https://www.uvigo.gal/es/universidad/administracion-personal/pdi/jose-oscar-rubinos-lopez
Mentored work	The students will be able to consult any doubt during this time of classes. If necessary, an appointment for tutoring with the faculty must be scheduled through the contact information provided in Moovi and the following link: Ana Vázquez Alejos @ https://www.uvigo.gal/universidade/administracion-persoal/pdi/ana-vazquez-alejos
Tests	**Description**
Presentation	To resolve doubts related to the presentation of mentored work, an appointment for tutoring with the faculty must be scheduled through the contact information provided in Moovi and the following link: Ana Vázquez Alejos @ https://www.uvigo.gal/universidade/administracion-persoal/pdi/ana-vazquez-alejos
Essay questions exam	To resolve doubts related to this test, an appointment for tutoring with the faculty must be scheduled through the contact information provided in Moovi and the following links: Marcos Arias Acuña @ https://www.uvigo.gal/es/universidad/administracion-personal/pdi/alberto-marcos-arias-acuna Oscar Rubiños López @ https://www.uvigo.gal/es/universidad/administracion-personal/pdi/jose-oscar-rubinos-lopez
Essay questions exam	To resolve doubts related to this test, an appointment for tutoring with the faculty must be scheduled through the contact information provided in Moovi and the following links: Marcos Arias Acuña @ https://www.uvigo.gal/es/universidad/administracion-personal/pdi/alberto-marcos-arias-acuna Oscar Rubiños López @ https://www.uvigo.gal/es/universidad/administracion-personal/pdi/jose-oscar-rubinos-lopez
Laboratory practice	For the delivery and assessment of the memory of the practices an appointment for tutoring with the faculty must be scheduled through the contact information provided in Moovi and the following link: Ana Vázquez Alejos @ https://www.uvigo.gal/universidade/administracion-persoal/pdi/ana-vazquez-alejos

Assessment

	Description	Qualification	Training and Learning Results	
Essay questions exam	Exam to solve short exercises focused to Units 1 and 2.	25	B20 B32	
Laboratory practice	For each laboratroy practice, a report of results will be presented individually.	30		D14 D23
Presentation	Oral presentation, individual or group, of the supervised work. The evaluation of each member of the group will be done through personalized monitoring.	15	B20 B32	D14 D23
Essay questions exam	Exam to solve short exercises focused to Units 3, 4 and 5.	30	B20 B32	D14 D23

Other comments on the Evaluation

Students enrolled in the subject can choose one of the two proposed assessment systems: continuous assessment or exam-only assessment. Each student must notify the coordinating professor by email of the selected assessment system one month after the start of classes.

Continuous assessment (ordinary exam)

Continuous assessment involves performing throughout the semester of the paragraphs disaggregated in the above table. Each of the blocks is of mandatory fulfillment in the form of continuous and individual assessment, and to pass the subject a minimum of 25% of the note assigned to each of the sections and the total mark accumulated within the five sections to be achieved must overcome at least 50% of the final grade.

The essay questions exams consist of a reasoned resolution of exercises on the subject topics. Regarding the block of laboratory practices, one report is required per practice and per student, made in a individual way. Evidences of report copying or cloning will drive to fail the related task.

Continuous assessment involves making 100% of all proposed tasks. Failure to take any of these tests implies the loss of continuous assessment and the final grade will be "SUSPENSO".

These tasks are not recoverable, that is, if a student does not satisfy the scheduled tasks, the teacher has no obligation to repeat any of them, and also they will be only valid for the academic year in which they are completed.

The schedule of the midterm/intermediate exams will be approved in the Comisión Académica de Máster (CAM) and will be available at the beginning of each academic semester.

It is considered that the subject is passed if the total grade is equal to or greater than 5. In case of leaving the modality of continuous assessment, the final grade will be "SUSPENSO".

Exam-only assessment (ordinary exam)

A student who does not opt for continuous assessment should be eligible for the highest grade by a final exam, which will consist of two parts:

- Part 1: realization of laboratory practices and delivery of reports due (50% of the final grade). One report is required per practice and per student, made in a individual way. Evidences of report copying or cloning will drive to grade as zero the related practice.

- Part 2: problem solving exam (50% of the final grade).

It is considered that the subject is passed by eventual assessment if the total grade is equal to or greater than 5.

Extraordinary exam

For students who chose the exam-only assessment, the grade will be given by a final exam that will consist of two parts: a practical examination (50%) and an examination of problems (50%) .

It is considered that the subject is approved in second call if the total grade is equal to or greater than 5.

End-of-program exam

It will consist of an exam with three parts: a practical examination (40%) and an examination of problems (60%). It is considered that the subject is approved if the total grade is equal to or greater than 5.

Ethical code and plagiarism

Plagiarism is regarded as serious dishonest behavior. If any form of plagiarism is detected in any of the tests or exams, the final grade will be FAIL (0), and the incident will be reported to the corresponding academic authorities for prosecution.

An ethical and critical use of tools based on artificial intelligence is recommended, and it is advisable to indicate their use in the reports delivered.

Sources of information
Basic Bibliography
Marcos Arias Acuña, Oscar Rubiños López, **Radiocomunicación**, 978-84-8408-603-1, Andavira Editoria, 2011
Ana Vázquez Alejos, **Guía de prácticas de laboratorio**,
Rolando Herrero, **Fundamentals of IoT communication technologies**, 978-3-030-70079-9, Cham : Springer, 2022
R. Buyya, A. V. Dastjerdi, **Internet of Things: Principles and paradigms**, 978-0-12-805395-9, Elsevier, 2016
Oriol Sallent, **Fundamentos de diseño y gestión de sistemas de comunicaciones móviles celulares**, 978-8-49-880482-9, Iniciativa Digital Politècnica, 2014
Complementary Bibliography
W. Dargie, C. Poellabauer, **Fundamentals of Wireless Sensor Networks: Theory and Practice**, 978-0-47-099765-9, Wiley, 2010

Leyre Azpilicueta, Cesar Vargas-Rosales, Francisco Falcone, Ana Alejos, **Radio Wave Propagation in Vehicular Environments**, 978-1-78561-823-9, Institution of Engineering and Technology (IET), 2020

Andreas F. Molisch, **Wireless Communications: From Fundamentals to Beyond 5G, 3rd Edition**, 978-1-119-11721-6, Wiley, 2022

Recommendations
Subjects that continue the syllabus
(*)Dispositivos IoT/V05M200V01101

IDENTIFYING DATA				
Análise de vídeo para vehículos conectados				
Subject	Análise de vídeo para vehículos conectados			
Code	V05M200V01222			
Study programme	Máster Universitario en Internet das Cousas- IoT			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Optional	1	2c
Teaching language				
Department				
Coordinator	López Ardao, José Carlos			
Lecturers				
E-mail				
Web	http://https://www.usc.gal/es/plan/19398/course/75/subject/19401-18495-3-103902			
General description	Materia coordinada pola USC. A guía docente está dispoñible no enlace indicado arriba			

Resultados de Formación e Aprendizaxe
Code

Resultados previstos na materia	
Expected results from this subject	Training and Learning Results

Contidos
Topic

Planificación			
	Class hours	Hours outside the classroom	Total hours
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Metodoloxía docente	
	Description

Atención personalizada

Avaliación		
Description	Qualification	Training and Learning Results

Other comments on the Evaluation

Bibliografía. Fontes de información
Basic Bibliography
Complementary Bibliography

Recomendacións

IDENTIFYING DATA				
Prácticas en empresa para IIoT				
Subject	Prácticas en empresa para IIoT			
Code	V05M200V01223			
Study programme	Máster Universitario en Internet das Cousas- IoT			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Optional	1	2c
Teaching language				
Department	Tecnoloxía electrónica			
Coordinator	Marcos Acevedo, Jorge			
Lecturers				
E-mail				
Web	http://https://www.usc.gal/es/plan/19398/course/75/subject/19781-18875-3-106196			
General description	Materia coordinada pola USC. A guía docente está dispoñible no enlace indicado arriba			

Resultados de Formación e Aprendizaxe
Code

Resultados previstos na materia	
Expected results from this subject	Training and Learning Results

Contidos
Topic

Planificación			
	Class hours	Hours outside the classroom	Total hours
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Metodoloxía docente	
	Description

Atención personalizada

Avaliación		
Description	Qualification	Training and Learning Results

Other comments on the Evaluation

Bibliografía. Fontes de información
Basic Bibliography
Complementary Bibliography

Recomendacións

IDENTIFYING DATA				
Prácticas en empresa para vehículo conectado				
Subject	Prácticas en empresa para vehículo conectado			
Code	V05M200V01224			
Study programme	Máster Universitario en Internet das Cousas- IoT			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Optional	1	2c
Teaching language				
Department	Tecnoloxía electrónica			
Coordinator	Marcos Acevedo, Jorge			
Lecturers				
E-mail				
Web	http://https://www.usc.gal/es/plan/19398/course/75/subject/19401-18495-3-106197			
General description	Materia coordinada pola USC. A guía docente está dispoñible no enlace indicado arriba			

Resultados de Formación e Aprendizaxe
Code

Resultados previstos na materia	
Expected results from this subject	Training and Learning Results

Contidos
Topic

Planificación			
	Class hours	Hours outside the classroom	Total hours
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Metodoloxía docente	
	Description

Atención personalizada

Avaliación		
Description	Qualification	Training and Learning Results

Other comments on the Evaluation

Bibliografía. Fontes de información
Basic Bibliography
Complementary Bibliography

Recomendacións