Teaching Guide				
Identifying Data				2023/24
Subject (*)	Distributed Registry Technologies and Blockchain		Code	614530106
Study programme	Máster Universitario en Ciberseguridade			
Descriptors				
Cycle	Period	Year	Type	Credits
Official Master's Degree	1st four-month period	First	Obligatory	5
Language	Spanish			
Teaching method	Face-to-face			
Prerequisites				
Department	Enxeñaría de Computadores			
Coordinador	Fraga Lamas, Paula	E-mail	paula.fraga@udc.es	
Lecturers	Fraga Lamas, Paula	E-mail	paula.fraga@udc.es	
Web	moovi.uvigo.gal			
General description	In this subject the student gains basic knowledge about Distributed Ledger Technologies (DLTs) and Blockchain.			

Study programme competences / results	
Code	Study programme competences / results
A26	HD-06 - Aplicar tecnologías de registro distribuido a casos de uso específico, así como diseñar, desarrollar y desplegar una solución basada en dichas tecnologías, optimizando sus parámetros esenciales y aplicando mecanismos de protección para evitar y mitigar ataques
B1	CB1 - To possess and understand the knowledge that provides the foundations and the opportunity to be original in the development and application of ideas, frequently in a research context
B2	CB2 - Students will be able to apply their knowledge and their problem-solving ability in new or less familiar situations, within a broader context (or in multi-discipline contexts) related to their field of specialization
B4	CB4 - Students will learn to communicate their conclusions ---and the hypotheses and ultimate reasoning in their support--- to expert and nonexpert audiences in a clear and unambiguous way
B5	CB5 - Students will apprehend the learning skills enabling them to study in a style that will be selfdriven and autonomous to a large extent
B22	K-06 - Comprender los conceptos básicos y el funcionamiento general de las tecnologías basadas en registro distribuido; así como su evaluación en términos de confidencialidad, integridad y disponibilidad; y sus principales aplicaciones y casos de uso
C7	C-02 - Demostrar autonomía e iniciativa para resolver problemas complejos que involucren múltiples tecnologías en el ámbito de las redes o los sistemas de comunicaciones, y desarrollar soluciones innovadoras en el campo de las comunicaciones y la computación distribuida privadas.
C9	C-04 - Aplicar la tecnología de cadenas de bloques a la protección descentralizada verificable de la información, ya sea referida ésta a activos digitales de información o referida a activos digitales que representan bienes de uso.

Learning outcomes			
Learning outcomes	Study programme competences / results		
Acquisition of the fundamental concepts associated with the design of Distributed Ledger Technologies (DLTs) and Blockchain.	AJ26	BJ1 BJ2 BJ4 BJ5 BJ22	CJ7 CJ9
Acquisition of knowledge to develop practical applications of Blockchain/DLT technologies.	AJ26	BJ1 BJ2 BJ4 BJ5 BJ22	CJ7 CJ9

Understanding the security issues and attacks on DLT and Blockchain technologies, as well as the mechanisms to minimize them.	AJ26	BJ1 BJ2 BJ4 BJ5 BJ22	CJ7 CJ9

Contents	
Topic	**Sub-topic**
History of Distributed Ledger Technologies (DLTs) and Blockchain.	Bitcoin architecture and operation. Decentralized governance. Smart contracts. Decentralized applications (DApps).
Fundamentals of DLTs and Blockchain.	Basic cryptography. Public key infrastructure. Consensus protocols. Peer-to-Peer (P2P) networks.
Types of Blockchain and DLT technologies.	Public vs. private blockchains. Permissioned blockchains.
Methodologies to determine the use of a Blockchain/DLT.	Flowchart to evaluate the use of a Blockchain/DLT.
Practical applications of Blockchain/DLT technologies.	Blockchain applications and use cases. Decentralized Autonomous Organizations (DAO). Metaverse. New business models.
Design and optimization of Blockchain/DLT-based architectures.	Deployment and governance of blockchain in cloud. Green Blockchain. Convergence of blockchain with other technologies (e.g., IoT, 5G/6G, AI).
Cybersecurity of DLT and Blockchain technologies.	Privacy in DLT and Blockchain technologies.

Planning				
Methodologies / tests	**Competencies / Results**	**Teaching hours (in-person & virtual)**	**Student?s personal work hours**	**Total hours**
Guest lecture / keynote speech	A26 B1 B22 C7 C9	21	21	42
ICT practicals	A26 B2 B4 B5 B1 B22 C7 C9	11	22	33
Supervised projects	A26 B2 B4 B5 B1 B22 C9	10	20	30
Objective test	A26 B4 B22 C9 C7	2	14	16
Personalized attention		4	0	4
(*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.				

Methodologies	
Methodologies	**Description**
Guest lecture / keynote speech	Exposition of the contents of the subject.
ICT practicals	Practices to develop the concepts acquired in the lectures.
Supervised projects	Development of projects with a theoretical and practical component.
Objective test	Assessment of the knowledge acquired throughout the course: practice and theory.

Personalized attention	
Methodologies	**Description**

Supervised projects ICT practicals	The professor will tutor the students and will guide them during the practical lessons. Part-time students and with attendance exemption academic waiver: it will not be required the attendance to the practical lessons. In the same way, tutoring will be adapted to the scheduling restrictions of the part-time students.

Assessment			
Methodologies	**Competencies / Results**	**Description**	**Qualification**
Supervised projects	A26 B2 B4 B5 B1 B22 C9	Development of projects with a theoretical and practical component.	40
ICT practicals	A26 B2 B4 B5 B1 B22 C7 C9	Evaluation of the results and knowledge acquired during the ICT practicals.	20
Objective test	A26 B4 B22 C9 C7	Evaluation of the competences acquired in the subject.	40

Assessment comments
FIRST CALL The practical part of the subject will consist in developing practical examples about the content of the theory lessons. Its evaluation will be performed progressively, with clear deadlines. The objective test will be divided into two parts: one oriented towards evaluating the practical developments and a second one about the theoretical content. Part-time students: attendance to the practical part will not be required. SECOND CALL AND EXTRA CALLS The students will have the opportunity to maintain the marks obtained during the ICT practicals and the supervised project. Such students will carry out a mixed test, establishing the final mark according to the same percentages applied for the first call. The rest of the students (including part-time students) will take a single mixed test of theory (40% of the total mark) and practice (20% of the total mark) and will carry out a supervised project (40% of the total mark). OTHER COMMENTS No marks will be preserved from one course to another. The fraudulent performance of tests or assessment activities, once verified, will directly involve the qualification of failed in the call in which it is committed: the student will be qualified with "failed" (numerical grade 0) in the corresponding call of the academic year, both if the offense is committed in the first opportunity as in the second. For this, the qualification will be modified in the first opportunity report, if necessary.

Sources of information	
Basic	- Phil Champagne (2014). The Book Of Satoshi: The Collected Writings of Bitcoin Creator Satoshi Nakamoto. E53 PUBLISHING LLC - Melanie Swan (2015). Blockchain: Blueprint for a New Economy. O?Reilly Media - Lorne Lantz, Daniel Cawrey (2020). Mastering Blockchain: Unlocking the Power of Cryptocurrencies, Smart Contracts, and Decentralized Applications. O?Reilly Media - Zibin Zheng, Wuhui Chen, Huawei Huang (2023). Blockchain Scalability. Springer - Rishabh Garg (2023). Blockchain for Real World Application. Wiley - Ethereum.org (2023). Ethereum Development Tutorials. https://ethereum.org/en/developers/tutorials/ - Solidity (2023). Solidity Programming Language . https://docs.soliditylang.org/en/latest/

Complementary	- Tiago M. Fernández-Caramés, Paula Fraga-Lamas (2018). A Review on the Use of Blockchain for the Internet of Things. IEEE Access - Paula Fraga-Lamas, Tiago M. Fernández-Caramés (2019). A Review on Blockchain Technologies for an Advanced and Cyber-Resilient Automotive Industry. IEEE Access - Tiago M. Fernández-Caramés, Paula Fraga-Lamas (2020). Towards Post-Quantum Blockchain: A Review on Blockchain Cryptography Resistant to Quantum Computing Attacks. IEEE Access - Tiago M. Fernández-Caramés, Paula Fraga-Lamas (2019). A Review on the Application of Blockchain to the Next Generation of Cybersecure Industry 4.0 Smart Factories. IEEE Access - Tiago M Fernández-Caramés, Oscar Blanco-Novoa, Iván Froiz-Míguez, Paula Fraga-Lamas (2019). Towards an autonomous industry 4.0 warehouse: A UAV and blockchain-based system for inventory and traceability applications in big data-driven supply chain management. Sensors

Recommendations
Subjects that it is recommended to have taken before
Subjects that are recommended to be taken simultaneously
Subjects that continue the syllabus
Other comments
This subject will comply with the different regulations for university teaching, respecting the gender perspective (e.g. non-sexist language will be used).

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