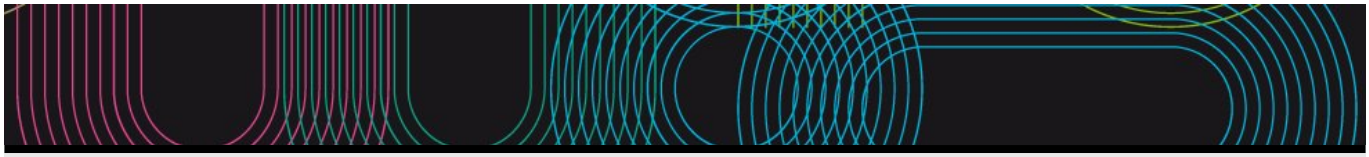

IDENTIFYING DATA				
Quantum Communications Networks				
Subject	Quantum Communications Networks			
Code	V05M198V01204			
Study programme	(*)Máster Universitario en Ciencia e Tecnoloxías de Información Cuántica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Optional	1st	2nd
Teaching language	Spanish			
Department				
Coordinator	Fernández Vilas, Ana			
Lecturers	Fernández Vilas, Ana González Castaño, Francisco Javier			
E-mail	avilas@uvigo.es			
Web	http://quantummastergalicia.es			
General description	It describes the conceptual basis and main elements of quantum communication networks, as well as their architecture. In addition, this vision is used to review a set of possible applications.			

Training and Learning Results	
Code	
A11	Acquiring a solid foundation on quantum theory gives information on its application in quantum communications, as well as on the technology of two photonic devices used in quantum communications, both terrestrial and aerial and via satellite.
A12	Acquire skills for the design and estimation of resources that allow the development of quantum communication channels and networks and distributed computing. Know the state of development and current implementation of quantum networks, and the plans for their expansion.
B11	Knowledge of quantum communications, theoretical principles and experimental implementations, both terrestrial and aerial and via satellite.
B12	To have knowledge about quantum cryptography, its theoretical bases, existing implementations and the challenges they face.
B13	To be aware of the physical and technical limitations of the implementation of quantum information treatment systems: noise, decoherence, etc., as well as the mitigation or correction strategies that are proposed.
C1	To analyze and break down a complex concept, examine each part and see how they fit together
C2	To classify and identify types or groups, showing how each category is different from the others
C3	To compare and contrast and point out similarities and differences between two or more topics or concepts

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

New	A14 A14 A11 A12 B18 B18 B11 B12 B13 C1 C2 C3

Contents	
Topic	
Introduction	What is QI? Entanglement exchange and distillation. Entanglement distribution.
IQ Elements	Quantum memories. Quantum repeaters. Bell pairs. Memory-based repeaters. Single-photonic repeaters. Entanglement paths.
Architecture of IQ	Architectures. Standardisation initiatives. Networks with trust repeaters. Networks without trust repeaters. Quantum states as resources. Quantum channel and QI capacity.
Applications	Distributed Quantum Computing. Interconnection of QPUs. Neural Networks and QNNs. QKD networks.

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	13	30	43
Case studies	4	10	14
Research based methodologies	4	10	14
Essay questions exam	2	0	2
Essay	1	0	1
Case studies	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	Lecturing
Case studies	Case studies
Research based methodologies	Research based methodologies

Personalized assistance	
Methodologies	**Description**
Lecturing	Personalised tutorials will be given to students who so wish, on any of the theoretical aspects of the subject, in accordance with the modality and timetable of each teacher. Ana Fernández Vilas [https://www.uvigo.gal/es/universidad/administracion-personal/pdi/ana-fernandez-vilas]
Case studies	Personalised tutorials will be provided to students who so wish, on any aspect of the case studies, in accordance with the modality and timetable of each teacher. Ana Fernández Vilas [https://www.uvigo.gal/es/universidad/administracion-personal/pdi/ana-fernandez-vilas]
Research based methodologies	Personalised tutorials will be given to students who so wish, on any of the proposed research topics, in accordance with the modality and timetable of each teacher. Ana Fernández Vilas [https://www.uvigo.gal/es/universidad/administracion-personal/pdi/ana-fernandez-vilas]

Assessment

	Description	Qualification			Training and Learning Results
Essay questions exam	Essay questions exam	40	A11	B11	C1
			A12	B12	C2
				B13	C3
Essay	Essay	30	A11	B11	C1
			A12	B12	C2
				B13	C3
Case studies	Case studies	30	A11	B11	C1
			A12	B12	C2
				B13	C3

Other comments on the Evaluation

There will be two assessment modalities in the ordinary exam: continuous assessment and global assessment. Continuous assessment consists of the submission of a research project and a case study from among those proposed in the contents. Each one will have a weight of 30% in the final grade, plus a written exam at the end of the course, with a weight of 40%.
The overall assessment will consist of a single written exam at the end of the course.
A student will be considered to have opted for the overall assessment if he/she does not hand in the first of the proposed activities. Continuous assessment precludes a final grade of not submitted.

Sources of information

Basic Bibliography

Rodney Van Meter, **Quantum Networking**, 1, Wiley, 2014

Riccardo Bassoli, Holger Boche et al, **Quantum Communication Networks. Foundations in Signal Processing, Communications and Networking**, 1, Springer, 2021

Peter P. Rohde, **The Quantum Internet: The Second Quantum Revolution**, 1, Cambridge University Press, 2021

Mohsen Razavi, **. An Introduction to Quantum Communications Networks Or, how shall we communicate in the quantum era?**, 1, Morgan & Claypool Publishers, 2018

Ivan Djordjevic, **Quantum Communication, Quantum Networks, and Quantum Sensing**, 1, Elsevier, 2022

Miralem Mehic , Stefan Rass , Peppino Fazio , Miroslav Voznak, **Quantum Key Distribution Networks: A Quality of Service Perspective**, 1, Springer, 2022

Complementary Bibliography

Recommendations