[GFK005] Quantum Computing

GENERAL INFORMATION

Studies	DEGREE IN ENGINEERING PHYSICS APPLIED TO INDUSTRY			**Subject**	Key Technologies
Semester	1	**Course**	4	**Mention / Field of specialisation**	???
Character	COMPULSORY				
Plan	2022	**Modality**	Face-to-face	**Language**	ENGLISH
Credits	4,5	**Hours/week**	0	**Total hours**	48 class hours + 64.5 non-class hours = **112.5 total hours**

PROFESSORS

GATTI ALVAREZ, GIANCARLO

REQUIRED PREVIOUS KNOWLEDGE

Subjects	Knowledge
Quantum Physics I	*(No previous knowledge required)*
Quantum Physics II	

LEARNING RESULTS

LEARNING RESULTS	KC	SK	AB	ECTS
GFR301 - Understands and implements quantum algorithms in real and simulated hardware, assessing quantum advantage and recognizing fundamental and state-of-the-art limitation	x	x		4,5
			Total:	4,5

KC: Knowledge or Content / SK: Skills / AB: Abilities

SECONDARY LEARNING RESULTS

RGF401 **Encodes classical problems into digital quantum systems and solves them in real or simulated NISQ architectures**

LEARNING ACTIVITIES	CH	NCH	TH
Presentation by the teacher in the classroom, in participatory classes, of concepts and procedures associated with the subjects	24 h.	32 h.	56 h.

EVALUATION SYSTEM	W
Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems	30%
Individual written and/or oral tests or individual coding/programming tests	70%

MAKE-UP MECHANISMS

Individual written and/or oral tests or individual coding/programming tests

CH - Class hours: 24 h.
NCH - Non-class hours: 32 h.
TH - Total hours: 56 h.

RGF402 **Understands the limitations and challenges for quantum advantage, as well as state-of-the-art methods to partially approach them**

LEARNING ACTIVITIES	CH	NCH	TH
Presentation by the teacher in the classroom, in participatory classes, of concepts and procedures associated with the subjects	24 h.	32,5 h.	56,5 h.

EVALUATION SYSTEM	W
Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems	30%
Individual written and/or oral tests or individual coding/programming tests	70%

MAKE-UP MECHANISMS

Individual written and/or oral tests or individual coding/programming tests

CH - Class hours: 24 h.

NCH - Non-class hours: 32,5 h.
TH - Total hours: 56,5 h.

CONTENTS

1. ENCODING CLASSICAL INFORMATION IN QUANTUM SYSTEMS [3h]
2. QISKIT BASICS [4h]
3. [AW1] GROVER’S SEARCH [3h]
4. NOISE CHARACTERIZATION AND CORRECTION [3.5h]
5. THE HARROW-HASSIDIM-LLOYD ALGORITHM (HHL) [2h]
6. QUANTUM VARIATIONAL ALGORITHMS [2h]
7. [AW2] QUANTUM APPROXIMATE OPTIMIZATION ALGORITHM (QAOA) — MAXCUT [2h]
8. THE LOADING AND RETRIEVAL PROBLEM [2h]
9. QUANTUM MACHINE LEARNING [3h]
10. [AW3] QUANTUM MACHINE LEARNING — KERNELS & CLASSIFICATION [3h]
11. UNIFICATION OF QUANTUM ALGORITHMS [3h]
12. STABILIZER CODES [2h]
13. TOPOLOGICAL ERROR CORRECTION [3h]

LEARNING RESOURCES AND BIBLIOGRAPHY

Learning resources	Bibliography
(No resources)	https://labur.eus/yM5qK