VNIVERSITAT DE VALÈNCIA

Course Guide
46708 Quantum Computing: Theory and Practical Applications

COURSE DATA

DATA SUBJECT

Code: 46708
Name: Quantum Computing: Theory and Practical Applications
Cycle: Master's Degree
ECTS Credits: 6
Academic year: 2026-27

STUDY (S)

Degree	Center	Acad. year	Period
2264 - Master's Degree in Quantum Technologies	Facultat de Física	1	First quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
2264 - Master's Degree in Quantum Technologies	Técnicas cuánticas	ELECTIVES

COORDINATION

SUMMARY

Introduction to quantum computing, from the fundamentals and main algorithms, alternative forms of quantum computing to the circuit model (quantum walks, measurement-based quantum computation), and the most recent developments in solving optimization problems. The course aims to provide a comprehensive overview, encompassing theoretical foundations and practical methods currently being tested. The course would be useful for students with an academic background, but would also provide useful training for entering the emerging sector of startups or companies in the quantum computing sector.

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

There are no specified enrollment restrictions with other subjects of the curriculum.

OTHER REQUIREMENTS

COMPETENCES / LEARNING OUTCOMES

DESCRIPTION OF CONTENTS

- Introduction to Quantum Computing
  Basic concepts: qubits, quantum gates, universality
  Fundamental algorithms: Deutsch-Josza, Simon, Grover, QFT, quantum estimation, Shor, quantum counting
  Introduction to Qiskit and algorithm programming
  Noise and error correction
  Other models of quantum computing
  Quantum computational complexity theory
  Practical quantum computing and programming applications

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Theory	60,00
Total hours	**60,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	0,00
Independent study and work	0,00
Preparation of lessons	0,00
Preparation for assessment activities	0,00
Resolution of case studies	0,00
Total hours	**0,00**

TEACHING METHODOLOGY

Master classes

Case studies

Programming or laboratory practices

Presentations on project work or problem deliverables

Seminars and conferences

Individual and/or group tutoring

EVALUATION

Assessment of participation in tutorials (minimum weighting of 10.0 and maximum weighting of 30.0)

Assessment of reports, practical exercises, and individual or group projects (minimum weighting of 20.0 and maximum weighting of 50.0)

Assessment of oral presentations (minimum weighting of 20.0 and maximum weighting of 50.0)

Assessment of the final oral or written exam (minimum weighting of 40.0 and maximum weighting of 80.0)

REFERENCES

M. Nielsen and I. Chuang, Quantum Computation and Quantum Information, Cambridge Univ. Press (2000).

A. M. Childs, Lecture Notes on Quantum Algorithms, University of Maryland, 30 May 2017,

R. de Wolf, Quantum Computing: Lecture Notes, University of Amsterdam

S. Gharibian, Lecture Notes on Quantum Complexity Theory, 2019,

J. Watrous, Quantum Computational Complexity, 2008

¿Quantum Computing for Highschool Students¿,

A. Montanaro, Quantum algorithms: an overview, npj Quantum Inf. 2, 15023 (2016),

S. Aaronson, Read the fine print, Nature Physics 11:291-293, 2015,