Digital 4 Business
Evolving your digital future

Quantum Computing

Transform your business with advanced computational theory and practical skills

Revolutionise business with advanced computational theory

Master cutting-edge technologies and develop practical skills for solving advanced computational problems.

Quantum computing is an evolving field that will revolutionise and expand computational power through quantum mechanics. With quantum systems now accessible via cloud platforms, this module offers a deep dive into the theoretical foundations and applications of quantum computing.

You'll gain hands-on skills in designing and applying algorithms to address computational challenges. The course also covers the current state and future possibilities of quantum computing, assessing its impact across industries and preparing you for its business use cases.

Learning objectives

This module covers the core principles of quantum computing, offering practical skills to design and implement algorithms for tackling complex computational challenges. By course completion, you'll not only understand the foundational theories but also be equipped to drive innovation in today's digital landscape. Here's what you'll accomplish:

- **Interpret and apply** quantum mechanical and mathematical concepts to qubit-based systems.
- **Critically assess** the distinctions and overlaps between quantum and classical computing.
- **Solve** complex problems using algorithms designed for quantum processors.
- **Apply** quantum gate circuit models in problem-solving and solution formulation.
- **Research and evaluate** the potential and real-world impact of quantum computing.

Criteria — are you eligible?

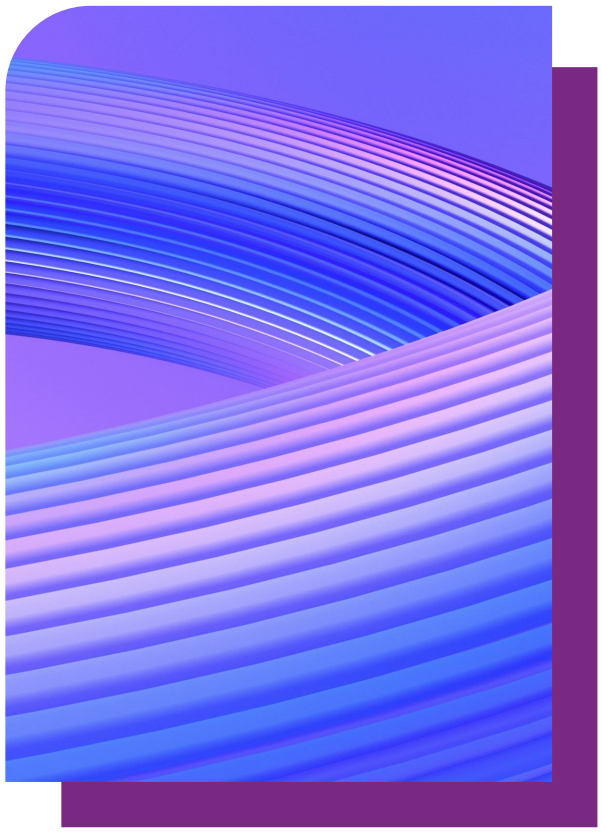
- **Language proficiency:** Minimum C1 English proficiency, plus 2 years' work or education in an English-speaking environment. IELTS: 6.0; TOEFL PBT: 600; TOEFL CBT: 200; TOEFL iBT: 100
- **Education:** Relevant EQF Level 6 qualification required (eg STEM, economics). Without this you will have an interview and assessment to evaluate certifications, qualifications or professional experience.
  EQF levels explained
- **Residency:** This EU-funded programme is open to all EU nationals with a passport or valid ID from one of the 27 EU countries.

Quantum Computing

Unlock new career paths and digital opportunities

This Quantum Computing course is perfect for tech enthusiasts, computer science students, IT professionals and data scientists.

It's designed for those eager to dive into cutting-edge technology and its real-world applications. Career prospects include quantum software developer, research scientist, data analyst or IT consultant.



An innovative online learning experience

This comprehensive online course integrates lectures, seminars, flipped classrooms, case studies, virtual labs, problem-based learning (PBL), peer reviews and collaborative work. Your progress is measured through both formative and summative assessments.

Formative assessments offer valuable feedback to enhance your learning strategy, while exams, projects and exercises evaluate your knowledge, skills and competencies. The proctored written test assesses your grasp of programming in business model development, with the final exam accounting for 100% of your grade.

Time commitment

- Classroom and demonstrations: 24 hours
- Practical work/tutorials: 24 hours
- Independent learning: 92 hours
- Total: 125 hours

Credit points

- 5 ECTS

Full course content

Subjects covered

Quantum Computing is a 5 ECTS module delivered over 4 hours per week for 12 weeks. Here's a schedule of the topics we'll cover each week:

- **Introduction**
  - Results from the theory of quantum mechanics
  - Spin and polarisation
  - Measurements/Observables
  - Randomness and probability
  - Bits and Qubits
  - Quantum parallelism and interference

- **Linear Vector Spaces, Hilbert Spaces, and Matrix Representations**
  - Review of linear spaces
  - Hilbert spaces
  - Dirac <bra|ket> notation
  - Operations and operators
  - The Bloch Sphere
  - Pauli Matrices
  - Orthogonal and unitary matrices
  - Operations and operators
  - Eigenvectors and eigenvalues

- **Quantum Circuits**
  - Logic Gates
  - Reversibility
  - Multi-qubit Gates
  - Diagrammatic representation
  - Deutsch's Algorithm

- **Programming for Quantum Computing**
  - Programming environments
  - Language support
  - Simulation
  - Quantum Computing cloud services
  - Coprocessor

- **Entanglement**
  - Entangled states
  - Bell's Inequalities
  - Using the CNOT gate
  - No Cloning Theorem
  - Quantum Teleportation

- **Quantum Information Theory**
  - Elements from the Classical Information Theory
  - Information and Entropy
  - Quantum Information Processing and Error-Correcting Codes
  - Quantum Communications Channels

- **Applications**
  - Quantum Cryptography
  - Quantum Key Distribution
  - Ekert Protocol
  - BB84 Protocol
  - Dense coding

- **Business / Domain Applications**
  - Applications of QC in Pharma, Finance, Cybersecurity, Machine Learning, Chemistry, etc.
  - Business Strategy & Innovation with QC

- **Quantum Fourier Transform**
  - Fourier Series
  - Discrete Fourier Transform
  - Quantum Fourier Transform

- **Quantum Algorithms**
  - Deutsch-Josza Algorithm
  - Simon's Algorithm

- **Quantum Algorithms**
  - Grover's Search Algorithm
  - Schor's Algorithm

- **Emerging Topics**
  - Quantum Hardware
  - Quantum Supremacy
  - Data Security
  - Quantum ML