UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Elements of Quantum Technologies

2526-3-E3001Q089

Aims

- The aim of the course is to provide a basic understanding of quantum technologies, including the various types of qubits and their control, quantum computing and communication, quantum sensing, the materials used in quantum technologies, and quantum materials. (DdD 1)
- The course is intended to equip students with the knowledge and skills necessary to understand the principles and applications of quantum technologies, preparing them for further study in this rapidly evolving field. (DdD 1,2,5)
- By the end of the course, students will be able to apply the acquired concepts to analyze simple quantum devices and assess their potential. (DdD 2)
- The course will also foster the ability to formulate critical judgments on the use of quantum technologies in various application contexts. (DdD 3)
- Attention will be given to the development of communication skills, through the presentation of concepts and results using appropriate technical language. (DdD 4)
- Finally, the course will provide a foundation for independently pursuing advanced topics in the field of quantum technologies. (DdD 5)

Contents

- Introduction of Quantum Information
- Quantum Hardware
- Qubit Control and Readout (SC qubits)
- Quantum Communication
- Quantum Sensing
- Materials for quantum hardware platforms
- Quantum Materials

Detailed program

Prerequisites

Mathematics and physics courses of the first two years of the Bachelor's Degree in Physics

Teaching form

In-person delivery teaching:
The course consists of 24 lessons, each 2 hours long, conducted in-person.
During the lessons, the fundamentals of quantum technologies will be presented.

Textbook and teaching resource

- Isaac Chuang and Michael Nielsen, "Quantum Computation and Quantum Information: 10th Anniversary Edition"
- Riccardo Manenti, Mario Morra, "Quantum Information Science"
- Daniel D. Stancil, Gregory T. Byrd, "Principles of Superconducting Quantum Computers"
- Phillip Kaye, Raymond Laflamme, Michele Mosca, "An Introduction to Quantum Computing"
- Serge Haroche, Jean-Michel Raimond, "Exploring the Quantum: Atoms, Cavities, and Photons'
- D.F. Walls, Gerard J. Milburn, "Quantum Optics"

Semester

Third year, second semester

Assessment method

The final exam consists of

- presenting an essay on one of a series of topics proposed by the lecturers
- oral discussion (not based on rote memorization)

For those who wish, it will be possible to take the exams in English.

Office hours

By appointment (online or in the office).

Sustainable Development Goals

INDUSTRY, INNOVATION AND INFRASTRUCTURE