UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Quantum Information and Quantum Computing

2526-1-F1703Q043

Aims

The aim of the course is to give an introduction to Quantum Information and Computing and to qubits, the basic elements of quantum computers and quantum technologies. The student will learn the fundamental theoretical basis to work and perform research in the emergent field of quantum technologies.

More in details

Knowledge and understanding: The student will learn the fundamental concepts of Quantum Computing and Quantum Information.

Applying knowledge and understanding: The student will learn to apply Quantum Computing and Quantum Information to the study of of quantum computers and quantum technologies.

Making judgments: The student will develop critical thinking and judgment skills in selecting the most appropriate tool, among those provided during the course, to solve a specific problem.

Communication skills: The student will be expected to acquire a correct and appropriate scientific language suited to the topics covered in the course.

Learning skills: The student will be able to deepen their understanding of specific concepts not covered during the course and to independently pursue advanced study using specialized scientific texts.

Contents

Introduction to the fundamental principles of quantum physics for Quantum Computing and Quantum Technologies: entanglements, Bell's inequalities, qubits and their physical realization, examples of quantum circuits and elementary algorithms.

Detailed program

— Basic elements of quantum mechanics

— Entanglement and Bell's inequalities

-- Quantum information

-- Qubits

— Quantum circuits

— Simple example of quantum algorithms

--- Examples of quantum correcting codes

-- Physical realization of qubits

Prerequisites

Knowledge of Quantum Mechanics at the level of the Bachelor degree (the basic notions necessary for this course will be reviewed)

Teaching form

lessons, 6 CFU, delivery mode, in presence

Textbook and teaching resource

Excellent books:

— Quantum Computation and quantum Information, Nielsen and Chuang

— quantum Computer Science, Mermin

Online lectures (if the link does not work anymore, google it!)

--Aaronson course at Austin

-- Preskill course at Caltech (advanced)

And a lot of online material about programming, but including lectures and videos on Quantum Computing and qubits, su https://qiskit.org/

Semester

first semester

Assessment method

oral exam with open questions on the entire program. It will be evaluated: knowledge of the topics, capacity of applying them and clarity of exposition.

Office hours

On student request, at agreed time

Sustainable Development Goals

QUALITY EDUCATION