Title	Code
Quantum computing (Informatyka kwantowa)	**1010401141010420781**
Field: **EDUCATION IN TECHNOLOGY AND INFORMATICS**	Year / Semester: **2 / 4**
Specialty: **-**	Course: **core**
Hours: Lectures: **2** Classes: **2** Laboratory: **-** Projects / seminars: **-**	Number of credits: **3**
	Language: **polish**

Lecturer:

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Status of the course in the study program:

Core course of the study for Education in Technology and Informatics, Faculty of Technical Physics.

Assumptions and objectives of the course:

making students familiar with selected problems of quantum computing

Contents of the course (course description):

The course presents selected fundamental problems of quantum computing. In the beginning fundamental concepts of quantum mechanics are discussed: quantum state in Hilbert space, orthonormal basis, quantum superposition of states, as well as fundamental properties of the operators (Hermitian, unitary), quantum measurement and projection operator. Further the concept of qubit (quantum bit) is addressed, its evolution and the methods of its state manipulation, correlations between qubits (in particular quantum entanglement) and decoherence. Further problems are concerned with quantum software ? quantum gates, fundamental quantum algorithms and error correction codes are discussed. The course presents also selected examples of physical quantum computers implementations (quantum hardware). The problems of quantum communication (quantum teleportation, quantum cryptography) are briefly addressed.

Lecture topics:

1.Elementary introduction to quantum computing
2.Fundamental problems of quantum physics (recollection); selected element sof quantum mechanics
3.Qubits, time evolution of a quantum state
4.Qubit states mannipulation. Quantum correlations, entangled states
5.Methods of obtaing entangled states. Bell?s inequalities
6.Pure and mixed states; density operator. Decoherence
7.Quantum gates
8.The simplest quantum algorithms ? Deutsch algorithm, Deutsch-Jozsa algorithm
9.Grover algorithm (searching an unstructured database)
10.Shor algorithm (number factorization into primes)
11.Quantum error correction. Physical implementations of quantum komputer ? criteria
12.Physical implementations of quantum komputer ? example 1
13.Physical implementations of quantum komputer ? example 2

14.Quantum teleportation, superdense coding
15.Quantum cryptography

Introductory courses and the required pre-knowledge:

basic knowledge of quantum physics and linear algebra

Courses form and teaching methods:

lecture ? PowerPoint presentation assisted
classes ? traditional form, solving of problems related to the course program

Form and terms of complete the course - requirements and assessment methods:

lecture: qualification test
classes: current assessment of students? progress, qualification test

Basic Bibliography:

1. J. Stolze, D. Suter Quantum Computing. A Short Course from Theory to Experiment Wiley-VCH, 2004
2. M. Le Bellac Wstęp do informatyki kwantowej Wydawnictwo Naukowe PWN, 2011
3. M. Hirvensalo Algorytmy kwantowe WSiP, 2004

Additional Bibliography:

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