GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Quantum Computing, PG_00048247		
Field of study	Informatics		
Date of commencement of studies	February 2024	Academic year of realisation of subject	2024/2025
Education level	second-cycle studies	Subject group	Optional subject group Subject group related to scientific research in the field of study
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	1	Language of instruction	Polish
Semester of study	2	ECTS credits	2.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Algorithms and Systems Modelling -> Faculty of Electronics, Telecommunications and Informatics		
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. inż. Krzysztof Giaro	
	Teachers	prof. dr hab. inż. Krzysztof Giaro	

Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	15.0	0.0	0.0	0.0	30
	E-learning hours included: 0.0						

Learning activity and number of study hours	Learning activity	Participation in didactic classes included in study plan	Participation in consultation hours	Self-study	SUM
	Number of study hours	30	4.0	16.0	50

Subject objectives	As a result of a better understanding of the behavior of microscopic objects, scientists at the end of the twentieth century created concepts for the use of microscopic phenomena to the non-classical information processing, communication, computing. These ideas have been extensively developed in the following decades, giving rise to the theory of quantum computers and quantum cryptography. The aim of the course is to present the main ideas of these concepts.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_W06] Knows and understands, to an increased extent, the basic processes taking place in the life cycle of devices, facilities and technical systems.	The student understands the provisional security status of modern cryptographic systems and the need to gradually replace them with solutions based on modern physics.	[SW1] Assessment of factual knowledge
[K7_U06] can analyse the operation of components, circuits and systems related to the field of study; measure their parameters; examine technical specifications; interpret obtained results and draw conclusions	Student can apply the conception of q-bit and quantum gates. Student models the execution of quantum gates circuit in a register.	[SU1] Assessment of task fulfilment
[K7_W02] Knows and understands, to an increased extent, selected laws of physics and physical phenomena, as well as methods and theories explaining the complex relationships between them, constituting advanced general knowledge in the field of technical sciences related to the field of study	The student understands the quantum description of states of physical systems and their evolution modeled using the formalism of Hilbert spaces and the operators.	[SW3] Assessment of knowledge contained in written work and projects
[K7_W01] Knows and understands, to an increased extent, mathematics to the extent necessary to formulate and solve complex issues related to the field of study.	The student understands the geometric properties of unitary spaces, formalism of linear operators, description of the complex system as a tensor product of spaces and operators.	[SW3] Assessment of knowledge contained in written work and projects
[K7_U01] can apply mathematical knowledge to formulate and solve complex and non-typical problems related to the field of study by:n-appropriate selection of source information and its critical analysis, synthesis, creative interpretation and presentation,n-application of appropriate methods and toolsn	Student describes the conception of q-bit and quantum gates. Student explains quantum cryptographic protocols and quantum teleportation.	[SU4] Assessment of ability to use methods and tools

Subject contents

1. History of quantum computing 2. Linear space 3. Hilbert space 4. Linear operators in Hilbert space 5. Axioms of quantum physics 6. Quantum bit and register 7. Quantum gates 8. Spin, EPR states and quantum and teleportation 9. Quantum cryptographic protocols 10. Probabilistic algorithms 11. Computation with quantum gates 12. Grovers search algorithm 13. BBHT search algorithm.

Prerequisites and co-requisites

Basics of:

- Linear Algebra

- Probability and Mathematical Statistics

- Fundamentals of Algorithm Analysis

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Midterm colloquium	40.0%	100.0%

Recommended reading

Basic literature

N. Nielsen, I. Chuang, Quantum Computation and Quantum Information, Cambridge University Press 2000.

J. Gruska, Quantum Computing, McGraw Hill 1999.

K. Giaro, Elementy kwantowego modelu obliczeń i algorytmiki kwantowej, OWSIiZ, 2013.

M. Hirvensalo, Algorytmy kwantowe, WSiP 2004.

	Supplementary literature	K. Giaro, M. Kamiński, Wprowadzenie do algorytmów kwantowych, Exit 2003 L. Tarasow, Podstawy mechaniki kwantowej, PWN 1984.
	eResources addresses	Adresy na platformie eNauczanie:
Example issues/ example questions/ tasks being completed		
Work placement	Not applicable	