University of Gdańsk

Subject card

Subject name and code	Physical Implementations of Quantum Information, PG_00159199						
Field of study	Quantum Information Technology						
Date of commencement of studies	October 2025		Academic year of realisation of subject	2026/2027			
Education level	Master's studies		Subject group	Obligatory subject group in the field of study			
Mode of study	full-time studies		Mode of delivery	at the university			
Year of study	2		Language of instruction	English			
Semester of study	3		ECTS credits	2.0			
Learning profile	academic		Assessment form	credit			
Conducting unit							
Name and surname of lecturer (lecturers)	Subject supervisor		prof. dr hab. Michał Horodecki				
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	0.0	0.0	0.0	15
	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	15		0.0		15.0	30
Subject objectives	To familiarize the students with experimental platforms relevant for implementations of quantum information techniques.						

<table>
<tr><td>Learning outcomes</td><td>
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<tr><th>Course outcome</th><th>Subject outcome</th><th>Method of verification</th></tr>
<tr><td>[QITL3_K02] is aware of the decisive role of experiment in the verification of physical theories; is aware of the existence of the scientific method in acquiring knowledge</td><td>Student knows details of experimental validation of Bell non-locality in optical systems.</td><td>[SK4] test/exam - oral or written</td></tr>
<tr><td>[QITL3_W03] knows advanced experimental, observational and numerical techniques allowing to plan and perform a complex physical experiment or computer simulation</td><td>Student knows details and challanges behind physical implementations of quantum systems in optical and solid state architectures.

Implementations of quantum information in with quantum optics, with ions and neutral cold atoms, as well as spins in semiconductor quantum dots, NV centers and molecules.</td><td>[SW4] test/exam - oral or written</td></tr>
<tr><td>[QITL3_U01] is able to apply the scientific method in solving physical problems and reasoning in the field of quantum information theory</td><td>Student can verify security of quantum communication protocols based on their experinental realisation</td><td>[SU4] test/exam - oral or written</td></tr>
<tr><td>[QITL3_W01] has extended knowledge in the field of general physics and advanced knowledge in the area of quantum information theory; knows the history of the development of quantum information theory and its importance for the progress of science, knowledge of the world and social development</td><td>Student knows history of experimental realisation of quantum systems</td><td>[SW4] test/exam - oral or written</td></tr>
<tr><td>[QITL3_U02] has the skills to plan and conduct basic and advanced research and calculations in the area of quantum information theory or its applications</td><td>Student can plan and conduct theoretical research in quantum information and physics in a regime which is accessible in available experimental settings.</td><td>[SU4] test/exam - oral or written</td></tr>
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<tr><td>Subject contents</td><td>Implementations of quantum information in with quantum optics, with ions and neutral cold atoms, as well as spins in semiconductor quantum dots, NV centers and molecules.</td></tr>
<tr><td>Prerequisites and co-requisites</td><td></td></tr>
<tr><td>Assessment methods and criteria</td><td>
<table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>essay</td><td>51.0%</td><td>100.0%</td></tr>
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<tr><td>Recommended reading</td><td>
<table>
<tr><td>Basic literature</td><td>Quantum computation and quantum information, Michael A. Nielsen & Isaac L. Chuang, Cambridge : Cambridge University Press, 2000</td></tr>
<tr><td>Supplementary literature</td><td>None.</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
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<tr><td>Example issues/ example questions/ tasks being completed</td><td></td></tr>
<tr><td>Work placement</td><td>Not applicable</td></tr>
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