University of Gdańsk

Subject card

Subject name and code	Introduction to Quantum Mechanics, PG_00205751		
Field of study	Quantum Information Technology		
Date of commencement of studies	October 2026	Academic year of realisation of subject	2026/2027
Education level	Master's studies	Subject group	Obligatory subject group in the field of study 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	English
Semester of study	1	ECTS credits	7.0
Learning profile	academic	Assessment form	exam
Conducting unit			
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Paweł Mazurek	
	Teachers		

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	60.0	0.0	0.0	0.0	90

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	90	0.0	85.0	175

Subject objectives

The aim of this course is to provide the student with the motivation behind postulates and tools of Quantum Mechanics, starting with two level photonic systems: polarization of a monochromatic electromagnetic wave and Malus law. Rigorous mathematical constructions are provided in the accompanying course Mathematical Methods of Quantum Information.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[QITL3_W01] knows and understands in depth selected facts, objects, and phenomena, as well as the methods and theories explaining the complex relationships between them, constituting advanced general knowledge in the field of quantum information technologies.		
[QITL3_U02] is able to use their knowledge of quantum information technologies – formulate and solve complex and unusual problems and perform tasks innovatively in unpredictable conditions by appropriately selecting sources and information derived from them, evaluating, critically analyzing, synthesizing, creatively interpreting, and presenting this information.		

<table>
<tr><td>Subject contents</td><td>* Inconsistencies in Classical Physics: Blackbody Radiation. Quantum Theory of Light and Plancks distribution, Photoelectric Effect, Compton Effect.

* Wave Nature of Matter : De Broglie Hypothesis. Wave-Particle Duality. Probability. Wave Amplitude and Wave Functions. Heisenbergs Uncertainty Principle. Single slit diffraction and the double slit experiment. MachZehnder interferometer.

* Basic Postulates and Formalism: Energy and Momentum Operators. Schrödinger Wave Equation. Properties and Interpretation of Wave Function and Probabilities. Linearity, Superposition and Collapse of wave functions. Eigenvalues, Eigenfunctions and Expectation Values.

* Applications of Schrodinger Equation: One dimensional box, Harmonic Oscillator, and Hydrogen Atom.

* Scattering Problems: Probability current and continuity equation. Tunnelling through Finite Potential Step, Attractive and Repulsive potential barriers.

* Approximation methods for stationary states: Time independent perturbation theory and its applications in atomic physics. Space quantization of angular momentum, Zeeman Effects and Spin angular momentum. Larmors precession.

* Diracs matrix Notation. Second quantization of harmonic oscillator. Ladder operators and their algebra.

* Quantum Entanglement and Bell Inequality. PPT criterion for entangled states and negativity.</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>None.</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>lecture part: exam</td><td>51.0%</td><td>50.0%</td></tr>
<tr><td>tutorial part: test</td><td>51.0%</td><td>50.0%</td></tr>
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<tr><td>Recommended reading</td><td><table>
<tr><td>Basic literature</td><td>Principles of Quantum Mechanics, Ramamurti Shankar

Quantum Computation and Quantum Information, Michael Nielsen, Isaac Chuang</td></tr>
<tr><td>Supplementary literature</td><td>None.</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
</table></td></tr>
<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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