

Subject card

Subject name and code	Introduction to Quantum Mechanics, PG_00158044						
Field of study	Introduction to Quantum Mechanics						
Date of commencement of studies	October 2025		Academic year of realisation of subject		2025/2026		
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	1		Language of instruction		English		
Semester of study	1		ECTS credits		6.0		
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	30.0	0.0	0.0	0.0	60
	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	60		0.0		30.0	90
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_W06] has knowledge of current directions in the development of physics, in particular in the field of quantum information theory		The student is aware about experiments, simulations and connection to mathematical formalism in the context of quantum correlations and Bell non-locality.		[SW4] test/egzamin - ustny lub pisemny		
	[QITL3_U01] is able to apply the scientific method in solving physical problems and reasoning in the field of quantum information theory		Student understands the connection between mathematical formalism and physical motivations of Quantum Mechanics, in particular is aware of quantum nature of photonic experiments		[SU4] test/egzamin - ustny lub pisemny		
	[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		Students know history of Quantum Mechanics and understands its experimental manifestations. Student understands the difference between resources provided by classical and quantum systems.		[SW4] test/egzamin - ustny lub pisemny		

Subject contents	* 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.		
Prerequisites and co-requisites	None.		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	tutorial part: test	51.0%	50.0%
	lecture part: exam	51.0%	50.0%
Recommended reading	Basic literature		Principles of Quantum Mechanics, Ramamurti Shankar Quantum Computation and Quantum Information, Michael Nielsen, Isaac Chuang
	Supplementary literature		None.
	eResources addresses		
Example issues/ example questions/ tasks being completed			
Work placement	Not applicable		

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