

COURSE OFFERED

Name of the course	Polish	Mechanika Kwantowa
	English	Quantum Mechanics

1. LOCATION OF THE COURSE OF STUDY WITHIN THE EDUCATION SYSTEM

1.1. Section¹	Section of Exact and Natural Sciences
1.2. Discipline²	Physical Sciences
1.3. Type of education	Stationary
1.4. Level of education	PhD School
1.5. Person preparing the course description	prof. dr hab. Francesco Giacosa
1.6. Contact	fgiacosa@ujk.edu.pl

2. GENERAL CHARACTERISTICS OF THE COURSE OF STUDY

2.1. Type of course³	specialized subjects in the discipline
2.2. Language of the course	English

3. DETAILED CHARACTERISTICS OF THE COURSE OF STUDY

3.1. Type of classes⁴	Lecture and classes
3.2. The number of hours⁵	15 h (lecture) + 15h (classes)
3.3. Location of classes	UJK, WNSiP
3.4. Type of assessment	Exam (lecture), pass with grade (classes)
3.5. Didactic methods	Oral lectures, problem solving
3.6. Literature	basic 1 J. J. Sakurai, Modern Quantum Mechanics 2 R. MacKenzie, Path integral methods and applications, quantph/0004090
	supplementary Quantum field theory in a nutshell, A. Zee, first chapter.

4. OBJECTIVES, SYLLABUS CONTENT AND INTENDEND LEARNING OUTCOMES

4.1. Course objectives (including the form of classes) Description of the most important features and formalism of modern quantum mechanics. Understanding the mathematical tools related to advanced quantum mechanics (focused on path integrals). Developing skills to solve exercises
Syllabus content 1. Recall of the fundamentals of QM: Schroedinger equation and its properties. 2. Recall of the fundamentals of QM: Heisenberg formalism and its properties. 3. Path integral in QM; formal derivation.

¹ Section of Humanities:, Social Sciences, Section of Exact and Natural Sciences, Section of Medical and Health Sciences, Section of Arts.

² History,Linguistics, Literary Studies, Medical Sciences, Health Sciences, Political and Administrative Sciences, Legal Sciences, Security Sciences, Pedagogy, Communication and Media Studies, Management and Quality Studies, Biological Sciences, Chemical Sciences, Physical Sciences, Earth and related Environmental Sciences, Visual Arts and Artwork Conservation, Musical Arts.

³ General courses, domain specific subjects in the section, disciplinary subjects in the sections, specialized subjects in the discipline.

⁴ Classes, lecture, seminar.

⁵ Consistent with the education program at the Doctoral School
Jan Kochanowski University in Kielce.

4. Examples of path integrals: free case, two-slit experiment.
5. Link of path integral to Quantum Field Theory.
6. Link of path integral to thermodynamics.
7. Perturbation theory and asymptotic series.
8. Recall of electrodynamics and the Aharonov-Bohm effect.
9. Spin: operators, commutations properties.
10. Composition of spins.

1. SUBJECT LEARNING OUTCOMES

Learning outcomes	A doctoral student who has passed the subject:	Reference to the learning outcomes of Doctoral School (according to the training program at the Doctoral School)
in the area of KNOWLEDGE:		
W01	Demonstrates knowledge and understanding at a level enabling the critical revision of existing paradigms of the global body of scholarship in quantum mechanics, encompassing theoretical foundations, general principles, and selected advanced topics.	SD_W01
W02	Understands the main developmental trends in scientific disciplines—particularly in quantum mechanics—relevant to the field of study and closely aligned with the pursued research topic.	SD_W02
W03	Understands the fundamental dilemmas of contemporary civilization and is able to formulate significant, current, and unresolved problems within the field of quantum mechanics, and can articulate these issues effectively in a foreign language.	SD_W07
in the area of SKILLS:		
U01	The doctoral student is able to define the aim and subject of scientific research, formulate research hypotheses in quantum mechanics, and critically analyze and evaluate research results, expert activities, and other scholarly or creative works, including their contribution to the advancement of knowledge..	SD_U01
U02	The doctoral student is capable of utilizing knowledge from various disciplines to identify, formulate, and creatively solve complex problems of quantum mechanics.	SD_U03
U03	Is able to use a foreign language at the B2 level of the Common European Framework of Reference for Languages (CEFR), enabling effective participation in an international professional environment, particularly in the field of quantum mechanics.	SD_U07
in the area of SOCIAL COMPETENCE:		

K01	Is ready to recognize the importance of knowledge in solving cognitive and practical problems.	SD_K02
K02	Is prepared to think and act in an entrepreneurial manner.	SD_K04

2. METHODS OF ASSESSMENT OF THE INTENDED LEARNING OUTCOMES

SUBJECT LEARNING OUTCOMES	METHOD OF ASSESSMENT (+/-)																				
	Oral/written exam			Test			Project			activity in class			Own work			Group work			Others		
	The type of classes			The type of classes			The type of classes			The type of classes			The type of classes			The type of classes			The type of classes		
	L	E	S	L	E	S	L	E	S	L	E	S	L	E	S	L	E	S	L	E	S
W01	x				x																
W02	x				x																
W03	x				x																
U01	x				x																
U02	x				x																
U03	x				x																
K01	x				x																
K02	x				x																

3. CRITERIA OF ASSESSMENT OF THE INTENDED LEARNING OUTCOMES

Form of classes	Grade	Criterion of assessment
Lecture (L) ⁶	3,0	51-60% correct exercises with exam
	3,5	61-70% correct exercises with exam
	4,0	71-80% correct exercises with exam
	4,5	81-90% correct exercises with exam
	5,0	91-100% correct exercises with exam
Exercises (E)	3,0	51-60% correct exercises with test
	3,5	61-70% correct exercises with test
	4,0	71-80% correct exercises with test
	4,5	81-90% correct exercises with test
	5,0	91-100% correct exercises with test

Accepted for execution

.....

⁶ Niepotrzebne usunąć.