Quantum mechanics foundations - course description

General information

Course name	Quantum mechanics foundations
Course ID	13.2-WF-FizP-QMF-S17
Faculty	Faculty of Physics and Astronomy
Field of study	Physics
Education profile	academic
Level of studies	First-cycle studies leading to Bachelor's degree
Beginning semester	winter term 2019/2020

Course information

Semester	5
ECTS credits to win	6
Course type	obligatory
Teaching language	english
Author of syllabus	• prof. dr hab. Piotr Rozmej • prof. dr hab. Krzysztof Urbanowski

Classes forms

The class form	Hours per semester (full-time)	Hours per week (full-time)	Hours per semester (part-time)	Hours per week (part-time)	Form of assignment
Lecture	30	2	-	-	Exam
Class	30	2	-	-	Credit with grade

Aim of the course

Familiarize students with the interpretation of quantum phenomena and mathematical foundations of the description of these phenomena.

Prerequisites

Familiarize students with the interpretation of quantum phenomena and mathematical foundations of the description of these phenomena.

Scope

Lecture:

1. Experiments and observations that led to the emergence of quantum mechanics.
2. Postulates of quantum mechanics.
3. Assigning operators to physical observables.
4. Eigenvalue problems for position, momentum and angular momentum operators.
5. Postulate on mean (expectation) values, intrpretation of the wave function.
6. Position representation, momentum representation.
7. Problem of simultaneous measurements of several physical quantities, uncertainty principle.
8. Time evolution, wave-particle duality
9. Hydrogen atom.
10. Harmonic oscillator
11. Potential barrier.
12. Spin and statistics, fermions, bosons.
13. Applications in medical physics.

Theoretical class: Problems and exercises for the lecture: elements of a theory of the linear operators in the Hilbert space, uncertainty principle, the square potential barrier, potential well, symmetries, , rotational symmetries - relationship with conservation laws.

Teaching methods

Conventional lecture, classes.

Learning outcomes and methods of theirs verification

Outcome description	Outcome symbols	Methods of verification	The class form

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The student understands the essence of quantum effects and processes, understands and can explain descriptions of physical phenomena and processes using mathematical language, can independently reproduce the claims and the rights and selected calculations. The student is able to create a theoretical model of the phenomenon and associate it with the results of measurements. The student can use the formalism of quantum mechanics to describe simple physical phenomena on the quantum level, is able to analyze and solve problems on the basis of physical knowledge and information from the available literature sources, databases and Internet resources. The student can independently acquire knowledge and develop their skills, using a variety of sources (in Polish and foreign) and new technologies. The student is aware of this knowledge and skills, and understands the need to know the possibilities of continuous further training in.	• K1A_W02 • K1A_W03 • K1A_U01 • K1A_U02 • K1A_U07 • K1A_K01	• a quiz • an exam - oral, descriptive, test and other • an observation and evaluation of activities during the classes	• Lecture • Class

Assignment conditions

Lectures: passing a final written exam,

Classes: passing a final test.

Before taking the examination the student needs to obtain passing grade in the computational exercises.

The final grade: the arithmetic average of the examination grade and computational exercises grade

Recommended reading

1. P. Rozmej, Foundation of quantum mechanics, pdf file for students.
2. S. Brandt, H.D. Dahmen, The picture book of quantum mechanics, Springer, 2001.

Further reading

[1] J. Brojan, J. Mostowski, K. Wódkiewicz, *Zbiór zadań z mechaniki kwantowej*, PWN 1978.

[2] L. I. Schiff, Mechanika kwantowa, PWN, 1977 (Quantum Mechanics, McGraw–Hill, New York).

Notes

Modified by dr hab. Piotr Lubiński, prof. UZ (last modification: 19-02-2020 22:34)