Quantum mechanics foundations - opis przedmiotu

Informacje ogólne

Nazwa przedmiotu	Quantum mechanics foundations
Kod przedmiotu	WFA-Erasmus-QMF
Wydział	Wydział Nauk Ścisłych i Przyrodniczych
Kierunek	WFiA - oferta ERASMUS
Profil	-
Rodzaj studiów	Program Erasmus
Semestr rozpoczęcia	semestr zimowy 2023/2024

Informacje o przedmiocie

Semestr	2
Liczba punktów ECTS do zdobycia	6
Typ przedmiotu	obowiązkowy
Język nauczania	angielski
Sylabus opracował	

Formy zajęć

Forma zajęć	Liczba godzin w semestrze (stacjonarne)	Liczba godzin w tygodniu (stacjonarne)	Liczba godzin w semestrze (niestacjonarne)	Liczba godzin w tygodniu (niestacjonarne)	Forma zaliczenia
Wykład	30	2	-	-	Egzamin
Ćwiczenia	30	2	-	-	Zaliczenie na ocenę

Cel przedmiotu

Introducing students to the historical development and basic concepts of quantum physics. In particular, to the interpretation of quantum phenomena and mathematical foundations of the description of these phenomena.

Wymagania wstępne

Assumed background:

Physics: Wave Mechanics, Electromagnetism and Optics.

Mathematics: Vector algebra, vector calculus, series and limits, partial differentiation, multiple integrals, first- and second-order differential equations, Fourier series, matrix algebra, diagonalisation of matrices, eigenvectors and eigenvalues, coordinate transformations, special functions.

Zakres tematyczny

Topics covered in Lectures:

1. Wave nature of light.
2. Experiments demonstrating failing of the wave nature of light: spectrum of X radiation, photoelectric effect, Compton scattering, discrete atomic spectra, black body radiation.
3. Planck's quantum hypothesis.
4. The Bohr model of the hydrogen atom and its difficulties.
5. Duality of light and matter.
6. Quantum wave mechanics, meaning of wave function and its interpretation.
7. Superposition principle. Wave packets and the Heisenberg uncertainty relation.
8. Operator representation of physical quantities. Non-relativistic Schrodinger equation.
9. Applications of the Schrodinger's equation: potential wells, potential barrier, tunneling effect.
10. Linear operators and their algebra. Eigenvalues and eigenvectors. Dirac notation.
11. Matrix representation of wave function and operators. Diagonalization of matrices.
12. Quantum harmonic oscillator.
13. Quantum wave mechanics model of hydrogen atom.

Tutorials: Solving problems and exercises on topics covered in the lectures: For example, problems and exercises on elements of a theory of the linear operators, uncertainty principle, the square potential barrier, potential well, eigenvalues and eigenvectors of operators. Matrix representation and diagonalization of matrices.

Metody kształcenia

Teaching and Learning Methods:

Two hours per week are scheduled for lectures and two hours for tutorials.

Lectures will cover the formal course content.

Typed lecture notes and tutorial problems will be provided.

In the problem solving tutorials, students will be expected to discuss the tutorial problems provided.

Efekty uczenia się i metody weryfikacji osiągania efektów uczenia się

Opis efektu	Symbole efektów	Metody weryfikacji	Forma zajęć
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.		• dyskusja • praca kontrolna • test końcowy	• Wykład • Ćwiczenia

Warunki zaliczenia

Course examination:

Lectures: Final written exam. Correct answer to at least 2/3 of questions.

Tutorial: Activity during the tutorial hours demonstrating the ability of solving tutorial problems and a positive grade of the final test.

Before taking the final lecture examination the student needs to obtain passing grade of the tutorials.

The final grade: the arithmetic average of the tutorial and lecture examination grades.

Literatura podstawowa

Main textbooks:

1. Z Ficek, *Quantum Physics for Beginners* (Pan Stanford, Singapore, 2016).

2. E. Merzbacher, *Quantum Mechanics*, (Wiley, New York, 1998).

3. D. J. Griffiths and D. F. Schroeter, Introduction to Quantum Mechanics (Cambridge University Press, 2021).

4. C. Cohen-Tannoudji, B. Diu, F. Laloe, Quantum Mechanics: Volume I: Basic Concepts, Tools, and Applications, Volume II: Angular Momentum, Spin, and Approximation Methods, (Wiley-VCH, 2019).

Literatura uzupełniająca

Important reference books are:

1. R.A. Serway, C.J. Moses, and C.A. Moyer, *Modern Physics*, (Saunders, New York, 1989).

2. K. Krane, *Modern Physics*, (Wiley, New York, 1996).

Uwagi

Zmodyfikowane przez dr hab. Sylwia Kondej, prof. UZ (ostatnia modyfikacja: 26-06-2023 15:53)