POZNAN UNIVERSITY OF TECHNOLOGY
EUROPEAN CREDIT TRANSFER AND ACCUMULATION SYSTEM (ECTS)
pl. M. Skłodowskiej-Curie 5, 60-965 Poznań

COURSE DESCRIPTION CARD - SYLLABUS

Course name
Quantum physics

Course

Field of study
Engineering Management

Area of study (specialization)

Level of study
First-cycle studies

Form of study
full-time

Year/Semester
2/4

Profile of study
general academic

Course offered in
polish

Requirements
elective

Number of hours

Lecture	Laboratory classes	Other (e.g. online)
15	15	
Tutorials	Projects/seminars	

Number of credit points

2

Lecturers

Responsible for the course/lecturer:
dr inż. Przemysław Głowacki
Email: przemyslaw.glowacki@put.poznan.pl

Faculty of Materials Engineering and Technical Physics
ul. Piotrowo 3, 60-965 Poznań

Responsible for the course/lecturer:

Prerequisites

A student starting this subject should have basic knowledge in mathematics and physics at the level of the first level of education.

The student has the ability to deepen understanding and interpretation of messages and effective self-education in the field related to the chosen field of study. Ability to work individually and work in a team.

Student has broadened awareness of the need to broaden his competences, readiness for individual work and cooperation within the team.

Course objective

Knowledge of phenomena and experiments confirming the quantum nature of radiation and the wave nature of matter (photoelectric effect, Compton phenomenon, de Broglie hypothesis). Familiarized with the history of the formation of atom models (with particular emphasis on the description of the atomic structure by Bohr) and with the modern model. Understanding Pauli exclusion principle for quantum objects and its consequences. Familiarization with quantum numbers describing the electron states of the atom and the description used in atomic physics. Presentation of the probalistic nature of quantum physics. Familiarization with the structure and principle of operation of the laser, as the main tool for studying objects in the quantum world, their excitation, detection, cooling and manipulation of quantum states on the example of free atoms and ions. Understanding the practical application of these phenomena and discoveries in quantum physics in technology and engineering on examples modern devices, such as a scanning tunnel microscope, atomic force microscope, quantum computer, CCD detectors, magnetic resonance, etc. Introduction to nuclear physics.

Course-related learning outcomes

Knowledge

1. describe and explain phenomena confirming the quantum nature of radiation and the wave nature of matter, characterize the structure of the atom based on the quantum description, knows the rules and exclusions applicable in the quantum world in the range covered by program content.

2. has knowledge about the use of quantum phenomena in modern technology and engineering, in particular in power engineering applications.

Skills

1. obtain specialized information from literature and the Internet, work individually and as a team, independently and collectively perform simple experiments / exercises in the field of quantum physics.

2. apply knowledge in the field of quantum physics for engineering and metrology applications in the field of power engineering.

3. is able to plan according to the instructions the measurement of selected phenomena / physical processes and interpret the results of these tests with a reference to quantum physics.

Social competences

1. understands the need to learn and deepen their knowledge throughout their lives, can inspire other people to the process of self-education, understands the need to formulate and communicate to the public information and opinions on the achievements of science and technology.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture:

- assessment of knowledge and skills demonstrated on the written exam of quantum physics issues to the extent covered by program content. Passing threshold 50% of points. Final issues on the basis of which questions are prepared will be sent to students by e-mail using the university e-mail system.

Laboratory exercises:

testing and rewarding the knowledge necessary to implement the set problems in a given area of laboratory tasks,

assessment of knowledge and skills related to the implementation of the exercise task, evaluation of the report from the exercise.

Obtaining additional points for activity during classes, and especially for:

- correct answers to questions asked during lectures,

- effectiveness of using the acquired knowledge while solving a given problem,

- remarks related to the improvement of didactic materials,

- aesthetic diligence of reports on laboratory exercises carried out as part of their own studies.

Programme content

Lectures:

Black body radiation - Planck's formula and the birth of quantum physics. Phenomena (experiments) confirming the quantum nature of radiation and the wave nature of matter. Models of the atomic structure (Kelvin, Thomson, Nicholson, Rutherford, Bohr and the contemporary model). The Pauli exclusion principle and its consequences. The probalistic nature of quantum physics (Schrödinger equation, Heisenberg's uncertainty principle, electron in a trap). Properties of atoms, atomic spectra, quantum numbers describing electron states of an atom. X-rays. Magnetic resonance imaging, magnetic imaging - MRI. Principle of laser operation, types of lasers due to their properties (power, mode of operation, generated radiation spectrum, active medium, application), laser class due to work safety, the use of lasers in science, technology and industry. Isotopes and methods for their separation. Selected issues of nuclear physics (description of the atomic nucleus, isotopes, atomic nucleus binding energy, radioactive decays).

Laboratory:

Laboratory exercises will be performed in three main departments: mechanics, electromagnetism and optics. From each department, students working in 2-person teams will have at least 2 exercises to complete. Exercise sets are presented in detail on the website of the physical laboratory (https://www.phys.put.poznan.pl/).

Teaching methods

Lectures: lecture with multimedia presentation (including drawings, photos, animations, video materials) supplemented with examples given on the blackboard, taking into account different aspects of the issues presented, including economic, environmental, legal and social issues, presenting a new topic preceded by a reminder of related content, known to students from other subjects.

Laboratory: detailed reviewing of reports by the laboratory's leaders and discussions on comments, demonstrations, work in teams.

Bibliography

Basic

1. D. Halliday, R. Resnick, J. Walker, „Podstawy fizyki, tom 5", PWN, Warszawa 2003

2. P. A. Tipler, R .A. Llewellyn, „Fizyka współczesna", PWN, Warszawa 2012

3.H. Haken, H. Ch. Wolf, „Atomy i kwanty - Wprowadzenie do współczesnej spektroskopii atomowej", PWN, Warszawa 2002

4. R. P. Feynman, R. B. Leighton, M. Sands, „Feynmana wykłady z fizyki. T. 3. Mechanika kwantowa", PWN, Warszawa 2014

5. St. Szuba, Ćwiczenia laboratoryjne z fizyki, Wydawnictwo Politechniki Poznańskiej, Poznań 2007

6. K. Łapsa, Ćwiczenia laboratoryjne z fizyki, Wydawnictwo Politechniki Poznańskiej, Poznań 2008

Additional

1. G. K. Woodgate, „Struktura atomu", PWN, Warszawa 1974.

2. R. Eisberg, R. Resnick, „Fizyka kwantowa", PWN, Warszawa 1983

3. A. K. Wróblewski, „Historia fizyki", PWN, Warszawa 2007

Breakdown of average student's workload

	Hours	ECTS
Total workload	60	2,0
Classes requiring direct contact with the teacher	30	1,0
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) [1]	30	1,0

[1] delete or add other activities as appropriate