COURSE DESCRIPTION CARD - SYLLABUS

Course name
Elements of Modern Physics [S1ETI2>EFW]

Course

Field of study
Education in Technology and Informatics

Year/Semester
2/3

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
15

Laboratory classes
0

Other
0

Tutorials
30

Projects/seminars
0

Number of credit points

4,00

Coordinators

dr hab. Eryk Wolarz prof. PP
eryk.wolarz@put.poznan.pl

Lecturers

Prerequisites

Knowledge of general physics within the scope acquired in the field of Technical and Information Technology Education.

Course objective

Familiarizing students with selected problems of modern physics. Developing the ability to analyze problems and solve tasks in this field.

Course-related learning outcomes

Knowledge:
1. Has basic knowledge of selected most important issues of modern physics.

Skills:
1. Is able to obtain information from literature, databases and other sources to solve simple problems in modern physics.

Social competences:

1. Is aware of the social role of a technical university graduate, and especially understands the need to formulate and convey to the public information and opinions regarding technical achievements based on the latest achievements in physics.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning effect Form of evaluation Evaluation criteria
written/oral exam 3 50.1%-70.0%
4 70.1%-90.0%
5 od 90.1%
test 3 50.1%-70.0%
4 70.1%-90.0%
5 od 90.1%
discussion during lectures and exercises
The student independently seeks a solution based on the acquired knowledge and shows great commitment to solving problems - the student receives an additional point to the result of the test for each presentation of the solution to the problem at the blackboard.

Programme content

Elements of relativistic mechanics, photons and matter waves, elements of quantum mechanics, atomic structure of matter, foundations of laser physics, metals and semiconductors, applications of semiconductors, elements of nuclear physics, elementary particles and the quark model.

Course topics

1. Postulates of special relativity.
2. Lorentz transformation.
3. Relativistic momentum, rest energy, total energy, kinetic energy.
4. Einstein's equation for the photoelectric effect.
5. Compton shift.
6. De Broglie wavelength.
7. Schroedinger's equation for one-dimensional motion.
8. Heisenberg's uncertainty principle.
9. Energy of an electron in an infinite potential well.
10. Wave functions of an electron in an infinite potential well.
11. Quantum dot.
12. Energy levels and spectral series for the hydrogen atom.
13. Quantum numbers in the hydrogen atom.
14. Orbital angular momentum of an electron in an atom and orbital dipole magnetic moment.
15. Spin angular momentum and spin magnetic moment.
16. Force acting on a silver atom in the Stern-Gerlach experiment.
17. Condition of nuclear magnetic resonance.
18. Pauli exclusion principle.
19. Kα line of characteristic X-ray radiation.
20. Features of laser light.
21. Absorption, spontaneous emission and stimulated emission.
22. System of bands and energy gaps for an insulator and a metal (diagram).
23. Definition of the Fermi level for a metal.
24. Definition of the density of states.
25. Fermi-Dirac statistics.
26. System of bands and energy levels for n-type and p-type semiconductors (diagram).
27. Charge distribution and electric potential at the p-n junction (diagram).
28. General diagram of the construction of a light-emitting diode (LED).
29. Definitions of atomic number and mass number.
30. Binding energy of the atomic nucleus.
31. Law of radioactive decay.
32. Half-life and mean lifetime.
33. β decay and α decay.

34. Definition of absorbed dose.
35. Basic nuclear models (specify).
36. Summary equation describing the fission of uranium 235U.
37. Critical, subcritical and supercritical states of a nuclear reactor.
38. Proton-proton cycle on the Sun (diagram).
39. Hadrons and leptons.
40. Conservation laws in elementary particle physics.

Teaching methods

Lecture: multimedia presentation, solving sample tasks on the blackboard.
Exercises: problem solving, practical exercises, discussion, team work.

Bibliography

Basic:
1. D. Halliday, R. Resnick, J. Walker, Podstawy fizyki, tom 4 i tom 5, Wydawnictwo Naukowe PWN, Warszawa, 2005.

Additional:
1. J. Orear, Fizyka, tom 2, Wydawnictwa Naukowo - Techniczne, Warszawa, 2004.
2. J. Massalski, Fizyka dla inżynierów. Część II. Fizyka współczesna, Wydawnictwa Naukowo - Techniczne,
Warszawa, 2005.

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	47	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	53	2,00