POZNAN UNIVERSITY OF TECHNOLOGY

EUROPEAN CREDIT TRANSFER AND ACCUMULATION SYSTEM (ECTS)

COURSE DESCRIPTION CARD - SYLLABUS

Course name
Molecular physics [S1FT2>FM]

Course

Field of study
Technical Physics

Year/Semester
2/4

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
30

Laboratory classes
15

Other (e.g. online)
0

Tutorials
15

Projects/seminars
0

Number of credit points

4,00

Coordinators

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Lecturers

Prerequisites

Basic general physics knowledge.

Course objective

1. To present students with knowledge in the field of molecular physics. 2. To introduce basic issues involving theoretical and experimental research methodologies of organic molecular systems. 3. To familiarize students with experimental techniques essential for understanding fundamental phenomena and processes in molecular systems. 4. To introduce the applications of molecular materials and their significance in present-day nanotechnology, medicine, and environmental protection.

Course-related learning outcomes

Knowledge:
Upon completion of the course, the student:
1. Can utilize molecular physics knowledge essential for describing laws governing phenomena in molecular systems; has organized and theoretically supported basic knowledge in molecular physics.
2. Understands physical processes, including classical and quantum processes in molecular systems, and knows the methodologies for researching these processes.

3. Can characterize molecular systems by defining their most significant material parameters for applications in nanotechnologies; has detailed knowledge related to selected issues of functional materials properties analysis and nano-scale processes.
4. Is aware of the current state of advancement and understands the latest developmental trends in nanotechnology, optoelectronics, bioelectronics; knows the need for applying molecular systems in optoelectronic technology, environmental protection, and photomedicine.
5. Possesses basic knowledge necessary for understanding the social, economic, and other non-technical conditions of engineering activities, including in the field of molecular physics.

Skills:
Upon completion of the course, the student:
1. Can determine processes occurring in organic molecular systems and their significance for nanotechnology; characterize material properties and their application in present-day nanotechnologies and natural sciences.
2. Can formulate simple conclusions based on calculation results and performed measurements, can use indicated knowledge sources with understanding, and acquire knowledge from other sources.
3. Can select molecular materials with appropriate physicochemical properties for laboratory and technological applications.

Social competences:
Upon completion of the course, the student:
1. Can cooperate with other students and in a professional team in the future; understands the need to formulate and communicate to society information and opinions regarding the achievements of technical physics, including molecular physics, and other aspects of engineering activities.
2. Can think and act creatively.
3. Understands the significance of contemporary subjects such as molecular physics in the development of nanotechnology and the broader progress of civilization and society.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Written/Oral Exam, Assessment of participation and activity in lectures.
Grades: 3 for 51%-70%, 4 for 70.1%-90%, 5 for over 90.1%.

Programme content

Fundamentals of molecular physics:
- structure of molecules,
- energies of molecules,
- spectroscopic methods for molecular studies,
- applications of molecular systems.

Course topics

1. Molecular systems, chemical bonds, molecular interactions.
2. Methods of solving issues in molecular systems.
3. Molecular energy, Boltzmann distribution of energy levels.
4. Molecular spectroscopy, types of spectroscopy, spectral band parameters.
5. Rotational energy; rotational spectroscopy.
6. Vibrational energy; infrared spectroscopy, Fourier transform.
7. Raman spectroscopy.
8. Electronic energy; Einstein's theory.
9. Jabłoński energy level diagram, radiative and non-radiative transitions, Franck-Condon approximation.
10. Absorption and emission, spontaneous and induced emission; Einstein's theory.
11. Absorption spectroscopy; Lambert-Beer's law. Emission spectroscopy.
12. Spectroscopy in unpolarized and polarized light, linear dichroism, fluorescence polarization.
13. Photothermal spectroscopy.
14. Research equipment for studying structures and molecular processes.
15. Applications of molecular systems in contemporary nanotechnology, medicine, and environmental protection.

Teaching methods

Lecture: Multimedia presentation, solving example tasks on the board.
Exercises: Solving calculation tasks, discussion.

Bibliography

Basic:
Danuta Wróbel, Podstawy fotonowych procesów molekularnych, Wydawnictwo Politechniki Poznaskiej, 1998

Additional:
Paul Suppan, Chemia i światło, Wydawnictwo Naukowe PWN,

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	62	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	38	1,50