# COURSE DESCRIPTION CARD - SYLLABUS

Course name
Molecular physics [S1FT1>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
0

Other (e.g. online)
0

Tutorials
15

Projects/seminars
0

## Number of credit points

3,00

## Coordinators

dr hab. inż. Łukasz Piątkowski prof. PP
lukasz.j.piatkowski@put.poznan.pl

## Lecturers

## Prerequisites

Basic knowledge of general physics.

## Course objective

Basic knowledge of general physics. Course objective 1. Introducing students to the knowledge of molecular physics. 2. Acquainting with the knowledge of basic issues including theoretical and experimental research methodology of molecular organic systems. 3. To familiarize students with experimental techniques necessary to understand the basic phenomena and processes occurring in molecular systems. 4. Introducing students to the area of application of molecular materials and their importance in modern nanotechnology, medicine and environmental protection.

## Course-related learning outcomes

Knowledge:
as a result of the conducted classes, the student:
1. can use the knowledge of molecular physics necessary to describe the laws governing phenomena in the field of the physics of molecular systems, has an ordered and theoretically founded basic knowledge of molecular physics - [k1_w02]

2. the student knows and understands physical processes, including classical and quantum processes occurring in molecular systems, and knows the methodology of studying these processes - [k1_w04]
3. the student is able to characterize molecular systems by determining their most important material parameters for applications in nanotechnologies, has detailed knowledge related to selected issues of analysis of the properties of functional materials and processes on the nano scale - [k1_w12]
4. the student knows the current state of advancement and is familiar with the latest development trends in the field of nanotechnology, optoelectronics, bioelectronics, the student knows the need to use molecular systems in optoelectronic technology, environmental protection and photomedicine - [k1_w13]
5. has basic knowledge necessary to understand social, economic and other non-technical determinants of engineering activity, including molecular physics - [k1_w16]

Skills:
as a result of the course, the student should demonstrate skills in the following areas (the student will be able to):
1. can define the processes that take place in molecular organic systems and their importance for nanotechnology, characterize the properties and material parameters and the way of their use in modern nanotechnologies and life sciences (in laser techniques, organic optoelectronics, organic photovoltaics, environmental protection). - [k1_u02]
2. is able to formulate simple conclusions based on the obtained results, calculations and measurements, use the understanding of the indicated sources of knowledge (list of basic literature) and acquire knowledge from other sources - [k1_u02]
3. can select molecular materials with appropriate physico-chemical properties for laboratory and technological applications - [k1_u17]

Social competences:
as a result of the course, the student will acquire the competences listed below. completing the course means that:
1. cooperate with other students and in the future in the professional team, understands the need to formulate and transfer information and opinions to the public on the achievements of technical physics, including molecular physics, and other aspects of engineering activities - [k1_k01]
2. can think and act in a creative way - [k1_k08]
3. understands the importance of modern subjects such as molecular physics in the development of nanotechnology and the general development of civilization and society. - [k1_k09]

## Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
Written / oral exam:
Assessment of participation and activity during lectures
3 - 51% -70.0%
4 - 70.1% -90.0%
5 - from 90.1%

## Programme content

1. Molecular systems, chemical bonds, molecular interactions.
2. Methods of solving problems of molecular systems.
3. Molecular energy, Boltzmann distribution of energy levels.
4. Molecular spectroscopy, types of spectroscopy, spectral parameters of spectral bands.
5. Rotational energy; rotational spectroscopy.
6. Oscillating energy; infrared spectroscopy, Fourier transform.
7. Raman spectroscopy.
8. Electronic energy; Einstein"s theory.
9. Jabłoński diagram of energy levels, radial and non-radiative transitions, Franck-Condon approximation.
10. Absorption and emission, spontaneous and forced emission; Einstein"s theory.
11. Absorption spectroscopy; Lambert-Beer law. Emission spectroscopy.
12. Spectroscopy in non-polarized and polarized light, linear dichroism, fluorescence polarization.

13. Photothermal spectroscopy.
14. Scientific research equipment for the study of molecular structures and processes.
15. Examples of the application of molecular systems in modern nanotechnology, medicine and environmental protection.

## Teaching methods

1. Lecture: multimedia presentation, solving example tasks on the blackboard,
2. Exercises: problem solving, discussion.

## Bibliography

Basic
1. Danuta Wróbel, Podstawy fotonowych procesów molekularnych, Wydawnictwo Politechniki Poznaskiej, 1998
Additional
1. Paul Suppan, Chemia i światło, Wydawnictwo Naukowe PWN,

## Breakdown of average student's workload

| | Hours | ECTS |
|---|---|---|
| Total workload | 65 | 3,00 |
| Classes requiring direct contact with the teacher | 45 | 2,00 |
| Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation) | 20 | 1,00 |