STUDY MODULE DESCRIPTION FORM

Name of the module/subject		Code
Molecular Physics		**1010401241010410034**
Field of study: **TECHNICAL PHYSICS**	Profile of study (general academic, practical): **general academic**	Year /Semester: **2 / 4**
Elective path/specialty: **-**	Subject offered in: **Polish**	Course (compulsory, elective): **obligatory**
Cycle of study: **First-cycle studies**	Form of study (full-time,part-time): **full-time**	
No. of hours: Lecture: **2** Classes: **1** Laboratory: **-** Project/seminars: **-**		No. of credits: **3**
Status of the course in the study program (Basic, major, other): **basic**	(university-wide, from another field): **university-wide**	

Education areas and fields of science and art	ECTS distribution (number and %)
technical sciences	**1 20%**
the sciences	**1 20%**
Physical sciences	**1 60%**

Responsible for subject / lecturer:

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Responsible for subject / lecturer:

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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Basic knowledge of experimental physics, atomic physics, quantum mechanics, mathematics
2	**Skills**	Skills in solving of physical problems on the experimental, atomic and quantum mechanics physics, atomic physics. Skills in getting information from the research data sources
3	**Social competencies**	Understanding of necessity to develop own competency, readiness for cooperation in a student team and other groups, and in taking decision in student community

Assumptions and objectives of the course:

1. Getting knowledge in molecular physics
2. Acquaint students with basic topics concerning theoretical and experimental studies of organic molecular systems
3. Acquaint students with physical techniques required to understand basic phenomena and processes occurring in molecular systems
4. Presentation of the possible applications of molecular materials and their significance in modern nanotechnologies
5. Interactive lecture ? to create students cooperation in a group

Study outcomes and reference to the educational results for a field of study

Knowledge:

1. student is able to take advantage of molecular physics indispensable for describing of principle of physics phenomena of molecular systems, has systematic basic theoretical knowledge in the field of molecular physics - [K_W02]
2. student knows and understands both classic and quantum processes occurring in molecular systems and knows methodology of their investigations - [K_W04]
3. student is able to characterize molecular systems by determining their most important material parameters essential for nanotechnological applications, has detailed knowledge on analyses of functional materials properties and processes occurring in the nanometer scale - [K_W12]
4. student is very knowledgeable about the development of modern molecular physics and knows the current state of the art and is well oriented in the newest trends in nanotechnology, molecular optoelectronics, bioelectronics; he knows a need of application of molecular systems in optoelectronics technology, environmental protection and photomedicine - [K_W13]
5. student has the basic knowledge required for understanding social, economical needs and other technical-off activities indispensable fin the molecular physics area - [K_W16]

Skills:

1. student is able to determine processes occurring in organic molecular systems and their significance for nanotechnology to characterize material properties and as well as a way of taking advantage from their exploitation in modern nanotechnologies, and natural science (laser techniques, organic optoelectronics, organic photovoltaics, environmental protection) - [K_U02]
2. student is able to draw simple conclusions on the basis of experimental measurements, obtained results, calculations, and to use literature data and to get new knowledge from another source - [K_U02]
3. student can select molecular materials of the best physics-chemical properties for laboratorial and technical applications - [K_U17]

Social competencies:

1. student is able to co-operate with other students and teams in the future and understands the needs to formulate and to transfer knowledge concerning achievement in technical physics and molecular physics as well as in other aspects of engineering activity - [K_K01]
2. student is able to think and act creatively [student is able to think and act creatively - [K_K08]
3. student understands significance of modern courses like molecular physics to development of nanotechnology and development of civilization and society - [K_K09]

Assessment methods of study outcomes

Oral exam:
3 - 51%-70.0%
4 - 70.1%-90.0%
5 ? from 90.1%
Assessment of participation and activity during lectures

Course description

1. Molecules, chemical bonding, molecular bonding, molecular structures.
2. Basic quantum methods for evaluation of molecular structure systems.
3. Energy of molecules. Boltzmann distribution. Population of molecular energy levels.
4. Types of molecular spectroscopy ? electronic, vibrational spectroscopies. Spectral parameters of spectral bands.
5. Molecule as a quantum pendulum. Vibrational energy.
6. IR spectroscopy. Fourier transformation. Raman spectroscopy.
7. Electronic energy. Einstein absorption and emission coefficients.
8. Jabłonski diagram. Energy levels. Radiative and non-radiative processes. Franck-Condon principle.
9. Absorption and fluorescence phenomena.
10. Absorption spectroscopy. Lambert-Beer low. Absorption parameters.
11. Fluorescence spectroscopy. Fluorescence parameters.
12. Spectroscopy in polarized light. Linear dichroism. Fluorescence anisotropy
13. Photothermal deactivation spectroscopy. Photoacoustics. Light-induced optoacoustics
14. Applications of molecular systems in modern optoelectronics and photomedicine.
15. Applications of molecular systems in environmental protection.

Basic bibliography:

1. H. Haken, H. C. Wolf , Molecular Physics and Elements of Quantum Chemistry, Introduction to Experiments and Theory, Springer, 2004
2. P. Suppan, Chemistry and Light, The Royal Society of Chemistry, 1994.

Additional bibliography:

Result of average student's workload

Activity	Time (working hours)
1. Participation in lectures	30
2. Participation in exercises	15
3. Consult with a lecturer	4
4. Preparation to an exam	14
5. Preparation to exercises	10
6. Exam	2

Student's workload		
Source of workload	**hours**	**ECTS**
Total workload	75	3
Contact hours	49	2
Practical activities	27	1