COURSE DESCRIPTION CARD - SYLLABUS

Course name
Functional Materials [S2ETI2>MatFunk]

Course

Field of study
Education in Technology and Informatics

Year/Semester
1/1

Area of study (specialization)
–

Profile of study
general academic

Level of study
second-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
0

Other
0

Tutorials
15

Projects/seminars
0

Number of credit points

3,00

Coordinators

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Lecturers

Prerequisites

Knowledge of experimental physics and mathematical analysis in the scope of the curriculum content implemented in semesters 1-4 at the 1st degree of education in the field of Education in Technology and Informatics. The ability to solve simple physical problems based on knowledge of experimental physics, the ability to obtain information from indicated sources. Understanding the need to expand your competences, readiness to cooperate within the team.

Course objective

1. Provide students with the knowledge of modern functional materials for molecular electronics, optoelectronics, sensors, photomedicine; informatiom about properties of zero- two- and three- dimensional structures in the nanometer scale, thin-layer organic structures, metamaterials, fullerenes, carbon nanotubes, graphene. 2. Developing the ability to select modern materials for applications in electronics and optoelectronics. Ability to search for applications and develop technologies for producing innovative devices. 3. Developing students' teamwork skills

Course-related learning outcomes

Knowledge:

1. knows the mathematical apparatus necessary to describe the laws of physics and knows the structures of basic electronic systems in the nanometer scale and functional materials and the requirements related to the properties of the materials used
2. knows the state of knowledge in the field of functional materials and is aware of the latest trends in this topic

Skills:
1. apply the basic laws of physics and simplified models to solve problems in the scope of the program content of the subject
2. prepare a well-documented study on issues related to new functional materials and their technical applications, including in optoelectronics
3. select materials with appropriate physicochemical and design properties for laboratory and engineering applications for creating new electronic component

Social competences:
1. understands the need and knows the possibilities of continuous learning and improving professional, personal and social competences
2. understands the importance of non-technical aspects and effects of engineering activities

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Effect. Form of evaluation. Evaluation criteria education
written / oral exam
Assessment criteria/assessment: in accordance with the study regulations

Programme content

The program content covers topics related to modern functional materials, their classification, properties, and significance in technology. The relationships between structure and physical properties such as electrical conductivity, magnetism, and mechanical strength are discussed.

Course topics

1. Functional materials, division of functional materials and their classification. Material science and the importance of functional materials in technology. Functional materials - correlations - electronic structure, atomic structure, micro and nano structure.
2. Properties of functional materials, mechanical, electrical, optical, magnetic and others.
3. Intelligent materials - sensor - actuator (definitions)
4. Metamaterials. The phenomenon of negative light coefficient, division of metamaterials, structure, applications.
5. Composite materials. Composites and nanocomposites. Classification of composite materials in terms of matrix and reinforcement.
6. Carbon materials: diamonds, nanotubes, graphene. Types of carbon nanotubes, folding of graphene layers, chiral vector. Methods of obtaining micro and nanodiamond thin-film structures. Influence of gas concentration on the behavior of the diamond structure (sp3 / sp2 hybridization) and characterization of structures by Raman light scattering. Characterization of graphene layers.
7. Thin-layer organic structures. Methods of obtaining and characterizing. Applications - advantages and disadvantages of thin-film organic structures.

Teaching methods

1. Lecture: multimedia presentation,
2. Exercises: problem solving, discussion.

Bibliography

Basic:
1. E. T. Dutkiewicz, Fizykochemia powierzchni, WNT, Warszawa, 1998
2. E. Wolarz, Metamateriały we współczesnej fizyce, materiały do wykładu
3. S. A. Ramakrishna, T. M. Grzegorczyk, Physics and Applications of Negative Refractive Index Materials,

CRC Press Taylor & Francis Group, Boca Raton, 2009
4. G. Turrel, J. Corset, Raman microscopy - development and applications, Elsevier Ltd., San Diego, California, USA, 1996
5. Fuel Cell Handbook, EG&G Technical Services, Inc., U.S. Department of Energy Office of Fossil Energy, National Energy Technology Laboratory, Morgantown, West Virginia, 2004
6. M. Bertrandt II pracownia fizyczna; Wydawnictwo Politechniki Poznańskiej , Poznań 2008
7. Barltrop J. A., Coyle J. D., Fotochemia ? podstawy, Warszawa, PWN 1987
8. R.W. Kelsall, I.W. Hamley, M. Geoghegan, Nanotechnologie, PWN, Warszawa, 2008

Additional:
1. R. Zieliński, Surfaktanty, Wydawnictwo AE, Poznań, 2000
2. T. Runka, K. Łapsa, A. Łapiński, R. Aleksiyko, M. Berkowski, M. Drozdowski, J. Mol. Structure, 704 (2004) 281-285
3. Lakowicz J., Principles of fluorescence spectroscopy, Plenum, NYC,1983
4. J. Szuber, Powierzchniowe metody badawcze w nanotechnologii półprzewodnikowej, Wydawnictwo Politechniki Śląskiej, Gliwice, 2002

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,00
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)	28	1,00