



COURSE DESCRIPTION CARD - SYLLABUS

Course name

Functional Materials

Course

Field of study

Year/Semester

Education in Technology and Informatics

1/1

Area of study (specialization)

Profile of study

general academic

Level of study

Course offered in

Second-cycle studies

english

Form of study

Requirements

full-time

compulsory

Number of hours

Lecture

Laboratory classes

Other (e.g. online)

30

Tutorials

Projects/seminars

15

Number of credit points

3

Lecturers

Responsible for the course/lecturer:

Responsible for the course/lecturer:

dr hab. Mirosław Szybowicz, prof PP

Phone: 616653170

Faculty of Materials Engineering and Technical
Physics

Piotrowo 3, 60-965 Poznań

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; information 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 [K2_W15], [K2_W16].

2. knows the state of knowledge in the field of functional materials and is aware of the latest trends in this topic [K2_W03], [K2_W15]

Skills

1. apply the basic laws of physics and simplified models to solve problems in the scope of the program content of the subject [K2_U13], [K2_U20].

2. prepare a well-documented study on issues related to new functional materials and their technical applications, including in optoelectronics [K2_U04].

3. select materials with appropriate physicochemical and design properties for laboratory and engineering applications for creating new electronic components [K2_U07], [K2_U08].

Social competences

1. understands the need and knows the possibilities of continuous learning and improving professional, personal and social competences [K2_K01].

2. understands the importance of non-technical aspects and effects of engineering activities [K2_K02].

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Effect. Form of evaluation. Evaluation criteria education

W01-W02 written / oral exam	3 - 50.1% -70.0%;
	4 - 70.1% -90.0%;
	5 - from 90.1%
U01-U3 test	3 - 50.1% -70.0%;
	4 - 70.1% -90.0%;
	5 - from 90.1%
K01-K02 written / oral exam	3 - 50.1% -70.0%;
	4 - 70.1% -90.0%;



5 - from 90.1%

Programme content

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 (sp^3 / sp^2 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

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. Grzegorzczak, 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	85	3,0
Classes requiring direct contact with the teacher	55	2,0
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) ¹	25	1,0

¹ delete or add other activities as appropriate