FACULTY OF FUNDAMENTAL PROBLEMS OF TECHNOLOGY
CHAIR OF EXPERIMENTAL PHYSICS
FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name in English:	**Physics of modern materials**
Name in Polish:	**Fizyka nowoczesnych materiałów**
Main field of study (if applicable):	***Civil Engineering***
Specialization (if applicable):	**Civil Engineering**
Level and form of studies:	**~~1st /~~ 2nd level*, full-time ~~/ part-time~~***
Kind of subject:	**obligatory / optional / university-wide***
Subject code:	**FZP007163**
Group of courses:	**~~YES /~~ NO***

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	**15**				
Number of hours of total student workload (CNPS)	**30**				
Form of crediting	~~Examination~~ / crediting with grade *	Examination / crediting with grade *	Examination-/ crediting with grade *	Examination / crediting with grade *	Examination-/ crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**1**				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	**0,5**				

* delete as appropriate

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES
Competences at mathematical analysis and general physics confirmed by the completed 1st degree studies of technical major.

SUBJECT OBJECTIVES	
C1	To posses the fundamental knowledge on physical effects determining the properties of modern materials and the knowledge necessary for proper understanding of the physical process in the nano-scale, and the applications of the modern materials.
C2	To posses fundamental skills of theoretical predictions, design and modelling of the physical properties of modern materials and nanomaterials.
C3	To posses and consolidate the competences allowing for the independent judgment on the influence of the discussed material technologies to the economy, social life and ecology.

SUBJECT EDUCATIONAL EFFECTS	
Relating to knowledge:	
PEK_W01	Possesses fundamental knowledge in quantum physics and physics of advanced materials and nanomaterials necessary to understand the physical processes determining the new properties of these systems.
Relating to skills:	
PEK_U01	Can solve simple calculational tasks in quantum physics and physics of advanced materials and nanomaterials.
PEK_U02	Can apply practically and technically the acquired knowledge on the modern materials.
PEK_U03	Is able to extend the knowledge on the modern materials using the information available in nowadays scientific publications.
Relating to social competences:	
PEK_K01	Understands the social, informative and technical meaning of the learned processes regarding the modern materials
PEK_K02	Is aware of the wide interconnection between different branches of the modern material technologies and their relation to the currently conducted fundamental studies, and to respective physical sciences

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours**
Lec1	Modern materials – review, history, nano-scale, current challenges and application-related demands	1
Lec2	Elements of condensed matter theory and and its relationship to electrical conductivity and optical properties; basic concepts; band gap; electrical conductivity; doping; absorption and emission of light; band gap engineering; semiconductor multicomponent alloys; manufacturing techniques and types of nanomaterials.	2
Lec3	Techniques for testing the structural characteristics and morphology of materials at the nano scale (electron microscopy, scanning electron microscopy, X-ray diffraction, mass spectrometry, etc.).	2
Lec4	Artificially fabricated periodic structures; atomic crystals and photonics crystals; spatial limitation for light; photonic crystals and manufacturing techniques; sample applications of nanostructures and advanced materials (lasers, alternative sources of energy, optical sensors, fiber optic sensors, etc.)	2
Lec5	Heat transport phenomena in volume stable solids, multi-layered and quasi-cristals; heat transfer by radiation and convection; thermal radiation and its use; methods of measurement of thermal conductivity and temperature.	2
Lec6	Carbon nanomaterials – fabrication, physical properties and applications: a. carbon nanotubes; b. graphen – two-dimensional carbon crystal; c. two-dimensional crystals of other materials; d. other carbon-based structures.	2
Lec7	Nanometals and nanofibres: a. Fabrication technologies; b. Physical properties;	2

	c. Application.	
Lec8	Other modern materials: a. dielectrics of high and low dielectric permittivity; b. superconductors; c. composites; d. concretes modified. Crediting colloquy	2
	Total hours	**15**

TEACHING TOOLS USED
N1. Informative lecture and multimedia presentation. N2. Consultations. N3. Independent student work and self-preparation to the course completion.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
P (lecture)	PEK_W01, PEK_U01, PEK_U02, PEK_U03	Colloquy

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Fundamentals of physics part 5, D. Halliday, R. Rescnick, J. Walker

[2] Low-dimensional semiconductor structures: Fundamentals and device applications, K. Bernham, D. Vvedensky

SECONDARY LITERATURE:

[1] B. Bhushan (Ed.), Springer Handbook on Nanotechnology.

[2] M. F. Ashby, P. J. Ferreira, D. L. Schodek, Nanomaterials, Nanotechnologies and Design.

[3] R. Cotterill, The material world.

[4] D. Vollath, Nanoparticles – Nanocomposites – Nanomaterials. An Introduction for Beginners.

[5] Y. Gogotsi, V. Presser, Carbon Nanomaterials.

[6] Theodore L. Bergman, Frank P. Incropera, Adrienne S. Lavine, Fundamentals of Heat and Mass Transfer, John Wiley&Sons

[7] K. Saraswat, Lectures on Low-k dielectrics, Stanford University: http://web.stanford.edu/class/ee311/NOTES/Interconnect%20Lowk.pdf

[8] K. Kurzydłowski, M. Lewandowska, "Nanomateriały inżynierskie. Konstrukcyjne i funkcjonalne.

SUBJECT SUPERVISOR (NAME AND SURNAME, DIVISION, E-MAIL ADDRESS)

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Physics of modern materials
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY ***Civil Engineering***
AND SPECIALIZATION **Civil Engineering**

Subject educational effect	**Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)****	**Subject objectives *****	**Programme content *****	**Teaching tool number *****
Knowledge				
PEK_W01	K2_W01, K2_W02	C1,C2,C3	Lec1- Lec5	N1,N2,N3
Skills				
PEK_U01	K2_W01, K2_W02	C1,C2	Lec2, Lec3-Lec5	N1,N3
PEK_U02	K2_W01, K2_W02	C1,C2	Lec4-Lec9	N1,N3
PEK_U03	K2_U01	C1,C2	Self-realized	N2,N3
PEK_U01	K2_W01, K2_W02	C1,C2	Lec2, Lec3-Lec5	N1,N3
Social competence				
PEK_K01	K2_K01, K2_K06	C2,C3	Lec1, Lec3, Lec4, Lec6-Lec9	N1,N3
PEK_K02	K2_K01, K2_K06	C3	Lec1, Lec3, Lec4, Lec6-Lec9	N1,N3

** - enter symbols for main-field-of-study/specialization educational effects
*** - from table above