

**COURSE OFFERED IN THE DOCTORAL SCHOOL**

Code of the course	4606-ES-00BDEGK-0343	Name of the course	Polish	Projektowanie, wytwarzanie i badania funkcjonalnych materiałów gradientowych					
			English	Designing, fabrication and investigation of functional graded materials					
Type of the course	Specialty lecture								
Course coordinator	prof. Katarzyna Konopka	Course teacher		prof. Katarzyna Konopka					
Implementing unit	Faculty of Materials Science and Engineering	Scientific discipline / disciplines*	Materials Engineering; Chemical sciences; Chemical Engineering; Automatic Control, Electronics, Electrical Engineering and Space Technologies; Biomedical Engineering						
Level of education	Doctoral studies	Semester	Summer						
Language of the course	English								
Type of assessment	Pass for assessment - final project with presentation	Number of hours in a semester	24	ECTS credits	2				
Minimum number of participants	10	Maximum number of participants	20	Available for students (BSc, MSc)	No				
Type of classes	Lecture	Auditory classes	Project classes	Laboratory	Seminar				
Number of hours	in a week	2	2	-	-	-			
	in a semester	12	12	-	-	-			

**1. Prerequisites**

Basic knowledge on materials and various methods of their synthesis.

**2. Course objectives**

Proposed course will be concentrated on Functionally graded materials (FGM) for various applications. The concept of designing of FGM and their microstructures and properties will be presented. Graded structure, methods of fabrication, properties and potential applications will be described and analysed. Lecture will be based on literature as well as on own investigated materials. The students will be realized individual projects of designing and describing the FGM.

**3. Course content (separate for each type of classes)**

**Lecture**

During the lecture the essential information as proposed will be presented:

- Conception of making graded structures of engineering materials
- Rules of design FGM
- Kinds of FGM
- Methods of fabrication of FGM
- Applications of FGM
- Examples of graded structures of engineering materials with analyses of their properties and applications
- Further perspectives in designing and fabrication of FGM

**Auditory classes**

During the auditory classes the practical exercises for students how to design, fabricate and investigate the FGM will be done. Final individual/group topic for the students will be elaborated based on the presented information.

4. Learning outcomes			
Type of learning outcomes	Learning outcomes description	Reference to the learning outcomes of the WUT DS	Learning outcomes verification methods*
Knowledge			
K01	Knowledge of the basics of bio-inspired engineering materials designing processing, properties and applications	SD_W2, SD_W3	project evaluation
K02	Knowledge of the possibilities of available methods of testing materials	SD_W2, SD_W3	project evaluation
Skills			
S01	Ability to use knowledge in the field of new bio-inspired engineering materials	SD_U1	project evaluation
S02	Ability to select a research methodology depending on the analyzed materials	SD_U1	project evaluation
S03	Ability to analyze the results of testing properties of materials and formulate relevant conclusions	SD_U2	project evaluation
S04	Improving teamwork skills;	SD_U7	project evaluation
Social competences			
SC01	Presentation of own concepts, analyses and guidelines and the ability to conduct an informed discussion in this area.	SD_K2	project evaluation

\*Allowed learning outcomes verification methods: exam; oral exam; written test; oral test; project evaluation; report evaluation; presentation evaluation; active participation during classes; homework; tests

5. Assessment criteria			
Preparing the tasks on the auditory classes and elaboration of the final topic related to FGM which will be checked by the teacher and discussed the results with students. Final mark will be given after discussion and presentation of work by student.			

6. Literature			
[1] books recommended by the teacher on the lectures			
[2] articles recommended by the teacher on the lectures.			

7. PhD student's workload necessary to achieve the learning outcomes**		
No.	Description	Number of hours
1	Hours of scheduled instruction given by the academic teacher in the classroom	24
2	Hours of consultations with the academic teacher, exams, tests, etc.	2
3	Amount of time devoted to the preparation for classes, preparation of presentations, reports, projects, homework	24
4	Amount of time devoted to the preparation for exams, test, assessments	
<b>Total number of hours</b>		<b>50</b>
<b>ECTS credits</b>		<b>2</b>

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\*\* 1 ECTS = 25-30 hours of the PhD student's work (2 ECTS = 60 hours; 4 ECTS = 110 hours, etc.)

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<b>8. Additional information</b>	
Number of ECTS credits for classes requiring direct participation of academic teachers	1
Number of ECTS credits earned by a student in a practical course	1