

### COURSE OFFERED IN THE DOCTORAL SCHOOL

Code of the course	4606-ES-00000EG-0230	Name of the course	Polish	Nowoczesne kompozyty o osnowie ceramicznej. Projektowanie, wytwarzanie, właściwości i zastosowania.		
			English	Novel ceramic matrix composites. Design, processing, properties and application.		
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 engineering			
Level of education	Doctoral studies	Semester	winter			
Language of the course	English					
Type of assessment	Pass for assessment - final project with presentation	Number of hours in a semester	30	ECTS credits	2	
Minimum number of participants	10	Maximum number of participants	20	Available for students (BSc, MSc)	Yes/No	
Type of classes		Lecture	Auditory classes	Project classes	Laboratory	Seminar
Number of hours	in a week	2	2	-	-	-
	in a semester	10	20	-	-	-

#### 1. Prerequisites

Basic knowledge on ceramics and related composites.

#### 2. Course objectives

Proposed course will be concentrated on novel ceramic matrix composites with complex structure. However, the background and basic knowledge of ceramic matrix composites will be firstly discussed. The concept of a novel ceramic matrix composites, designing of their microstructure and properties will be presented. Processing, properties and potential applications will be analysed and presented at the examples of composites base on literature as well as on own investigated materials. The individual projects of student will be realized.

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

##### Lecture

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

- Background of ceramic matrix composites
- Classification of ceramic matrix composites
- Reinforcement (metal, intermetallic material)
- Microstructure of ceramic-metal and ceramic-intermetallic composites
- Interfaces in ceramic matrix composites
- Nanocomposites
- Hybrid composites
- Fabrication of ceramic matrix composites
- Properties of ceramic matrix composites
- Applications of ceramic matrix composites
- New approach in designing of ceramic matrix composites.

Auditory classes
During the auditory classes the practical exercises for students how to design, fabricate and investigated of ceramic matrix composites will be done. Final individual topic for the student 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 ceramic and ceramic matrix composites 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 materials engineering – ceramic matrix	SD_U1, SD_U2, SD_U3, SD_U4	project evaluation
S02	Ability to select a research methodology depending on the analyzed materials	SD_U1, SD_U2, SD_U3, SD_U4	project evaluation
S03	Ability to analyze the results of testing properties of materials and formulate relevant conclusions	SD_U1, SD_U2, SD_U3, SD_U4	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 ceramic matrix composites which will be checked by lecturer and discussed the results with students. Final mark will be given after discussion and correction of work by student.

6. Literature
[1] K. Konopka, A. Miazga, Kompozyty ceramika-metal, Oficyna Wydawnicza PW [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	10

2	Hours of consultations with the academic teacher, exams, tests, etc.	20
3	Amount of time devoted to the preparation for classes, preparation of presentations, reports, projects, homework	20
4	Amount of time devoted to the preparation for exams, test, assessments	10
<b>Total number of hours</b>		<b>60</b>
<b>ECTS credits</b>		<b>2</b>

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

<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