Warsaw University of Technology

COURSE OFFERED IN THE DOCTORAL SCHOOL

Code of the course	4606-ES-000EIKP-0280	Name of the course	Polish	**Nanozanieczyszczenia środowiska: źródła, występowanie, analiza i losy**
			English	**Environmental nanopollutants: sources, occurrence, analysis and fate**
Type of the course	Specialty course			
Course coordinator	Prof. Ryszard Łobiński, Ph.D., D.Sc., Eng	Course teacher		
Implementing unit	Faculty of Chemistry	Scientific discipline / disciplines*	chemical sciences, chemical engineering, environmental engineering, mining and energy, biotechnology	

Level of education	Doctoral studies	Semester	spring		
Language of the course	English				
Type of assessment	Graded credit, ZAL	Number of hours in a semester	30	ECTS credits	2
Minimum number of participants	12	Maximum number of participants		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	20				10

* does not apply to the Researcher's Workshop

1. Prerequisites

Fundamentals of chemistry and/or environmental sciences

2. Course objectives

Introduce the subject, define nanopollutants and their classification. Discuss typical problems related to the presence of individual classes of nanopollutants (metal-containing, carbon-based, nanoplastics etc.) in different environmental compartments and their interaction with aquatic organisms and plants. Students will be introduced to the principles of analytical techniques used in environmental analysis of nanopollutants. The analytical approaches discussed will be focused number concentration, size and size distribution determination as well as imaging techniques at the single cell level. The existing European Union Legislation addressing nanosafety and the environment and perspectives for its development will be presented.

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

Lecture

- Occurrence of nanoparticles in different environmental compartments: an overview
- The challenge of the analysis of nanoplastics in the environment: current status and perspectives
- Presence of carbon-based nanomaterials in the environment: current analytical challenges and uncertainties
- Uptake of metal-containing engineered nanoparticles by aquatic organisms and plants and their possible transfomations
- Analytical tools for the environmental analysis of nanopollutants: determination of number concentration, size, size distribution, transformation products and imaging at cellular level
- Nanosafety legislation in Europe and perspectives of its development - the focus on the environment

Seminar

Presentation of a selected problems related to the presence of nanopollutants in the environment.

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	Student is able to identify different sources and individual classes of nanopollutants in environment	SD_W1	evaluation of activity during class, presentation evaluation
K02	Student is familiar with state-of-the-art analytical instrumental techniques adapted to study different aspects of the presence of nanopollutants in environmental compartments	SD_W2	evaluation of activity during class, presentation evaluation
Skills			
S01	The student is able to identify sources of emissions, propose a strategy for monitoring the degree of environmental contamination and a method for the determination of relevant aspects of the presence of nanopollutants in environmental compartments	SD_U1 SD_U3 SD_U4 SD_U5 SD_U6	evaluation of activity during class, presentation evaluation
S02	Students is able to discuss problems related to the presence of different classes of nanopollutants in environmental compartments on the basis of specialized scientific English-language literature	SD_U3 SD_U4 SD_U5 SD_U6	evaluation of activity during class, presentation evaluation
Social competences			
SC01	The student understands the importance of on-going research related to the presence of nanopollutants in different environmental compartments. He/she is able to popularize this knowledge and understands the importance of complying with EU regulations in this area.	SD_K2 SD_K3 SD_K4	evaluation of activity during class, presentation 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

Active presence during lectures and seminars will produce the final grade.

6. Literature

Primary references:

[1] Environmental Nanopollutants: Sources, Occurrence, Analysis and Fate, Editors: Joanna Szpunar, Javier Jiménez-Lamana, Royal Society of Chemistry, 2022 DOI DOI:10.1039/9781839166570

[2] Alimi, O.S., Farner Budarz, J., Hernandez, L.M., Tufenkji, N., Microplastics and Nanoplastics in Aquatic Environments: Aggregation, Deposition, and Enhanced Contaminant Transport, (2018) Environmental Science and Technology, 52 (4), pp. 1704-1724, DOI: 10.1021/acs.est.7b05559

[3] Bundschuh, M., Filser, J., Lüderwald, S., McKee, M.S., Metreveli, G., Schaumann, G.E., Schulz, R., Wagner, S. Nanoparticles in the environment: where do we come from, where do we go to? (2018) Environmental Sciences Europe, 30 (1), art. no. 6, DOI: 10.1186/s12302-018-0132-6

55 h, w tym: 1. Godziny kontaktowe 15 h - obecność na wykładach; 2. przygotowanie do egzaminu i obecność na egzaminie 40 h;

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	20
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	20
4	Amount of time devoted to the preparation for exams, test, assessments	18
	Total number of hours	**60**
	ECTS credits	**2**

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

8. Additional information	
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