

Course syllabus

binding for the doctoral students of the CUT Doctoral School commencing their studies
in the academic year 2022/2023

Information on the course

Name of the course in Polish	Nowoczesne metody syntezy
Name of the course in English	Modern methods for synthesis
Number of the ECTS points	1
Language of instruction	Polish
Category of the course	Elective
Field of education	Engineering and Technology
Discipline of education	Chemical Engineering
Person responsible for the course Contact	Prof. Dariusz Bogdał, <i>doctus hab.</i> , DSc dariusz.bogdal@pk.edu.pl

Type of course, number of hours in the study programme curriculum

Semester	Credit type (G / NG)*	Lecture	Practical class	Laboratory	Computer laboratory	Project class	Seminar
2	G	15	0	0	0	0	0

*G – graded credit, NG – non-graded credit

Course objectives

Code	Objective description
Objective 1	To expand knowledge on modern methods of chemical synthesis; microwave radiation, ultrasounds, mechanochemistry.
Objective 2	To acquaint the doctoral student with the design, principles of operation and scaling possibilities of microwave, ultrasonic and mechanochemical applicators and devices.
Objective 3	To acquire the ability to select appropriate methods of chemical synthesis and to plan unit processes using microwave radiation, ultrasounds, mechanochemistry.

Learning outcomes

Code	Description of the learning outcome adjusted to the specific characteristics of the discipline	Learning outcome symbol in the CUT SD	Methods of verification
OUTCOMES RELATED TO KNOWLEDGE			
EUW1	The doctoral student understands the phenomena and effects of the interaction of microwave radiation, ultrasounds and mechanical energy with matter.	E_W01	Involvement in class activities

EUW2	The doctoral student knows the principles of operation and design of microwave and ultrasonic devices.	E_W02	Involvement in class activities
OUTCOMES RELATED TO SKILLS			
EUU1	The doctoral student is able to determine the effects of microwave radiation and ultrasounds on materials.	E_U01	A written assignment
EUU2	The doctoral student is able to plan chemical syntheses and unit operations using microwave, ultrasonic and mechanochemical techniques.	E_U02	A written assignment
OUTCOMES RELATED TO SOCIAL COMPETENCES			
EUK1	The doctoral student is prepared to use bibliographic databases and critically assess the techniques and design of devices used in chemical synthesis as well as the results of research reported in the subject literature.	E_K03	Discussion
EUK2	The doctoral student is aware of the responsibility for the research tasks carried out in teamwork.	E_K01	Discussion

Course outline

No.	Contents	Learning outcomes for the course	No. of hours
LECTURE			
W1	Introduction and definition of the scope and conditions for completing the course. Literature available.	E_K03	1
W2	Microwave radiation – characteristics, interaction with matter – liquids, solids – parameters determining radiation absorption.	E_W01, E_U01	2
W3	Devices used to generate microwave radiation – magnetrons, applicators, waveguides, chambers as well as mineralisers and reactors.	E_W02, E_U01	2
W4	Scaling of microwave devices and applicators. Examples of industrial microwave radiation in use.	E_U02, E_K01	2
W5	Ultrasounds – characteristics, interaction with matter – liquids, solids – observations of cavitation.	E_W01, E_U01	2
W6	Devices used to generate ultrasounds – applicators, chambers and reactors. Examples of shared use of ultrasounds and microwave radiation.	E_W02, E_U02	2
W7	Mechanochemistry – principles and examples of devices for conducting chemical reactions.	E_W02, E_U02	1
W8	Scaling up ultrasonic devices. Intensification of chemical processes and container 'factories'.	E_K01	1

The ECTS points statement

WORKING HOURS SETTLEMENT	
Type of activity	Average number of hours (45 min.) dedicated to the completion of an activity type
SCHEDULED CONTACT HOURS WITH THE ACADEMIC TEACHER	
Hours allotted in the syllabus	15
Consultations	1
HOURS WITHOUT THE PARTICIPATION OF THE ACADEMIC TEACHER	

Independent study of the course contents	4
Preparation of a paper, report, project, presentation, discussion	5
ECTS POINTS STATEMENT	
Total number of hours	25
The ECTS points number	1

Preliminary requirements

No.	Requirements
1	Completion of the courses: the basics of physics and the basics of chemistry.
2	English language skills at B2 level.

Course credit assignment conditions / method of the final grade calculation

No.	Description
COURSE CREDIT ASSIGNMENT CONDITIONS	
1	80% attendance in class. Presentation of a written paper.
METHOD OF THE FINAL GRADE CALCULATION	
Evaluation of the written paper.	

Additional information

None

The course reading list

1	D. Bogdal, M. Galica, <i>Introduction to Microwave Chemistry</i> in: Microwave Engineering of Nanomaterials, Stanford Publishing, 2016, Stanford, USA.
2	Muthupandian Ashokkumar et al., <i>Handbook of Ultrasonics and Sonochemistry</i> , Springer, 2016, Singapore. https://link.springer.com/referencework/10.1007/978-981-287-278-4#toc