



## COURSE CARD

### 1. Basic information

Course name in English:	Advanced analytical methods using mass spectrometry and spectroscopy NMR	
Course name in Polish:	Zaawansowane metody analityczne z zastosowaniem spektrometrii mas i spektroskopii NMR	
Number of hours:	30	
Type of course:	Elective course	
Form of course:	lecture	
Code of course:	W03NCH-SD0058W / NCQ100353W	
Course leader:	Prof. dr hab. Piotr Młynarz	
Faculty of the course leader:	W3 Faculty of Chemistry	
Email address of the course leader:	Piotr.mlynarz@pwr.edu.pl	
Scientific discipline(s) assigned to the course (doctoral students representing the marked disciplines can participate in the course):	Architecture and urban planning	<input type="checkbox"/>
	Automation, electronic, and electrical engineering	<input type="checkbox"/>
	Information and communication technology	<input type="checkbox"/>
	Biomedical engineering	<input checked="" type="checkbox"/>
	Chemical engineering	<input checked="" type="checkbox"/>
	Civil engineering and transport	<input type="checkbox"/>
	Mechanical engineering	<input type="checkbox"/>
	Environmental engineering, mining, and energy	<input checked="" type="checkbox"/>
	Mathematics	<input type="checkbox"/>
	Chemical sciences	<input checked="" type="checkbox"/>
	Physical sciences	<input checked="" type="checkbox"/>
	Management and quality studies	<input type="checkbox"/>

### 2. Objectives

1. To acquaint students with the issues of applying analytical methods in chemical sciences, biological sciences (biological and environmental systems)
2. To acquaint students with the issues of using spectroscopic and spectrometric methods in material chemistry
3. Providing students with issues that relate to advanced spectroscopic methods
4. Providing students with issues that relate to advanced spectrometric methods
5. To acquaint students with scientific literature and examples

### 3. Content

*Detailed information about the course content, including topics and form of classes.*

No.	Topic	Number of hours	Form of classes
1	Introduction to spectroscopic methods	2	lecture



2	One-dimensional NMR in analytical studies	4	lecture
3	Advanced 2D and 3D methods in structural research	4	lecture
4	Chromatographic NMR	1	lecture
5	Introduction to spectrometric and separation methods	6	lecture
6	Liquid chromatography coupled with mass spectrometry	5	lecture
7	Gas chromatography coupled with mass spectrometry	4	lecture
8	Application of analytical biological research platforms	2	lecture
9	Application of analytical platforms in material chemistry research	2	lecture
10			Select form
11			Select form
12			Select form
13			Select form
14			Select form
15			Select form

#### 4. Prerequisites

List of prerequisites relating to knowledge, skills and other competences for course participants.

1. Basic knowledge of organic chemistry
2. Knowledge of analytical and instrumental chemistry
3. Basic knowledge in the field of NMR spectroscopy and MS mass spectrometry

#### 5. Learning outcomes

List of learning outcomes at level 8 of the Polish Qualifications Framework assigned to the course (mark the learning outcomes in the last column).

Symbol	Learning outcome	
	<i>KNOWLEDGE. Doctoral student knows and understands:</i>	
SzD_W3	the main trends in the development of the scientific or artistic disciplines covered in the curricula;	<input checked="" type="checkbox"/>
SzD_W4	research methodology;	<input checked="" type="checkbox"/>
SzD_W5	the rules for the dissemination of scientific results, including in open access mode;	<input type="checkbox"/>
SzD_W6	the fundamental dilemmas of modern civilization;	<input type="checkbox"/>
SzD_W7	the legal and ethical conditions of scientific activity;	<input type="checkbox"/>
SzD_W8	the economic and other relevant conditions of scientific activity;	<input type="checkbox"/>
SzD_W9	basic principles of knowledge transfer to the economic and social spheres and commercialisation of results of scientific activity and know-how related to these results.	<input type="checkbox"/>
	<i>SKILLS. Doctoral student is able to:</i>	



SzD_U2	use knowledge from different fields of science or art to creatively identify, formulate and innovatively solve complex problems or perform research tasks, in particular: - define the purpose and subject of scientific research, formulate a research hypothesis, - develop research methods, techniques and tools, and use them creatively, - draw conclusions on the basis of scientific research; critically analyse and evaluate the results of scientific research, expertise and other creative work and their contribution to knowledge development; transfer the results of scientific activities to the economic and social spheres;	<input checked="" type="checkbox"/>
SzD_U3	communicate on specialised topics to the extent that they enable an active participation in the international scientific community;	<input checked="" type="checkbox"/>
SzD_U4	disseminate research results, including in popular forms;	<input checked="" type="checkbox"/>
SzD_U5	initiate debates and participate in a scientific discourse;	<input type="checkbox"/>
SzD_U6	be able to speak a foreign language at B2 level of the Common European Framework of Reference for Languages to a level that enables them to participate in the international scientific and professional environment;	<input checked="" type="checkbox"/>
SzD_U7	plan and implement an individual or collective research or creative activity, including in an international environment;	<input type="checkbox"/>
SzD_U8	independently plan and act for one's own development and inspire and organize the development of others;	<input type="checkbox"/>
SzD_U9	plan classes or groups of classes and implement them using modern methods and tools.	<input type="checkbox"/>
<i>SOCIAL COMPETENCES. Doctoral student is ready to:</i>		
SzD_K3	fulfilling the social obligations of researchers and creators, initiate public interest activities, thinking and acting in an entrepreneurial way;	<input type="checkbox"/>
SzD_K4	maintaining and developing the ethos of research and creative environments, including: - carrying out scientific activities in an independent manner, - respecting the principle of public ownership of research results, taking into account the principles of intellectual property protection.	<input checked="" type="checkbox"/>

## 6. Evaluation

*Short description of the method(s) used to evaluate the learning outcomes assigned to the course, e.g., exam, test, report, presentation, etc.*

Assessment of learning outcomes: pass

## 7. Teaching methods

*Short description of the teaching methods used during the course, e.g., multimedia presentation, discussion, literature studies, developing written documents, own work, etc.*

lecture with multimedia presentation, discussion, literature studies

## 8. Literature

*List of primary and secondary literature used to prepare the course and including additional knowledge for participants, e.g., books, textbooks, research papers, standards, web pages, etc.*



1. Analytical Separation Science tom 1-5 Edited by Jared L. Anderson, Alain Berthod, Veronica Pino, Apryll M. Stalcup, Wiley-VCH, Second edition 2013
- [2] Translation Dymanimcs and Megnetic Resonance, Paul T. Callghan, Oxford Uniwersity Press, 2011
- [3] Spektroskopowe metody identyfikacji związków organicznych, Silverstein Robert M., Webster Francis X., Kiemle David J., Wydawnictwo Naukowe PWN, 2012
- NMR Spectroscopy, Gunther Harald, Wiley-VCH Verlag GmbH, 2013
- 4] Elsevier Science Publishing Co Inc, 2015
- [5] Fundamentals of Mass Spectrometry, Kenzo Hiraoka, Springer Science & Business Media
- [6] Introduction to mass spectrometry, J. Throck Watson, John Wiley & Sons 2013
- [7] Handbook of Advanced Chromatography /Mass Spectrometry Techniques, Academic Press and Aocs Press. 2017
- 8 NMR Data Interpretation Explained: Understanding 1d and 2D NMR Spectra of Organic Compounds and Natural Products, Neil E. Jacobsen, Wiley, 2016

## 9. Other remarks

*Additional remarks, comments, (e.g., language of the course)*