

Faculty of Pharmacy with the Division of Laboratory Medicine						
<b>Faculty</b>	<b>Doctoral studies</b> in the field of medical sciences, discipline: medical biology		<b>Qualification level and study mode</b>	III cycle studies	full-time	
<b>Course title</b>	<b>Modern analytical techniques in biomedical sciences</b>		<b>ECTS points</b>		<b>3</b>	
<b>Department</b>	Department of Inorganic and Analytical Chemistry		<b>Course coordinator</b>		Prof. dr hab. Elżbieta Skrzydlewska	
<b>Course format</b>	compulsory	Semester IV	<b>Type of classes and no. of hours</b>	lectures 0	classes 24h	seminars 6h
<b>Course aim and objectives</b>	Introducing doctoral students to the theory and use of modern separation techniques with mass spectrometer detection in biomedical sciences					
<b>Course description</b>	<p><b>seminars</b> Discussion of methods of sample preparation of biological material [blood, plasma, cerebrospinal fluid, urine, solid tissues] for analytical determinations taking into account specific requirements for the research techniques used. Using separation techniques [gas chromatography, liquid chromatography] with quadrupole, ion trap, QTOF, and electromigratory detectors for determination of endogenous and exogenous substances in body fluids. Quality control – validation of analytical methods.</p> <p>Discussion of separation techniques and analytical tools dedicated to proteomic, metabolomics, and lipidomic studies, i.e. gas/liquid chromatography with mass spectrometry detection (TOF, QTOF, QOrbiTrap). Discussion of methods of sample preparation of biological material for individual determinations and limitations to the methodologies used.</p> <p><b>classes</b> Comparison of possibilities for determination [sensitivity, selectivity, detection, and determinability level] of an arachidonic acid metabolite, iso-8 Prostaglandin F<sub>2α</sub>, in blood plasma with the use of LCMS with ion trap and triple quadrupole detectors. Method validation. Using two-dimensional GCGC/MS gas chromatography for assessing the levels of glycated proteins in plasma of elderly people.</p> <p><i>Proteomics.</i> Isolation and quantitative analysis of proteins from biological samples with a complex matrix. Performing electrophoretic separation, in-gel protein digestion, and analysis of extracted peptides with separation by column chromatography and detection using an OrbiTrap mass spectrometer. Interpretation of results.</p> <p><i>Metabolomics.</i> Performing subsequent stages of the procedure of sample preparation of biological material for fingerprinting analysis with the use of the LC-QTOF technique. Isolation and quantitative analysis of proteins from biological samples with a complex matrix. Discussion of individual stages of processing of the obtained data taking into account elements of statistics and the types of final identification of metabolites (putative identification, using standards of chemical compounds and MS\MS spectra analysis).</p> <p><i>Lipidomics.</i> Isolation of the lipid fraction from biological material with the use of various methods. Quantitative assessment of phospholipid content in individual classes after prior separation with the use of the TLC technique. Obtaining the lipidomic profile for previously obtained extracts with the use of the LC-QTOF set. Identification of lipid compounds and interpretation of results. Performing target lipidomic analysis of selected lipid mediators.</p>					
<b>Forms and methods of instruction</b>	seminar with multimedia presentation and discussion laboratory classes					
<b>Requirements and assessment</b>	The classes end with assessment on the basis of evaluation of students' active participation in classes, evaluation of presentations on analytical techniques used by doctoral students in everyday scientific work, and evaluation of practical completion of classes. The course ends with an oral exam – discussion on a given topic					
<b>Basic literature</b>	Witkiewicz Z.: Podstawy chromatografii. WNT, Warszawa 2005.					

	<p>Kamiński M.: Chromatografia cieczowa. Centrum Doskonałości Analityki i Monitoringu Środowiskowego, Gdańsk 2004</p> <p>Kikkelsen S., Corton E. Bioanalytical chemistry, Wiley-Interscience, 2004</p> <p>Metabolomics: Methods and Protocols (Methods in Molecular Biology). Weckwerth, Wolfram (Ed.). Springer 2007; ISBN 978-1-59745-244-1.</p> <p>Metabolomics, Metabonomics and Metabolite Profiling (RSC Publishing) Edited by William J. Griffiths. RSC, Cambridge 2008; ISBN 978-0-85404-299-9.</p> <p>Lipidomics Volume 1 2009 Methods and Protocols (Methods in Molecular Biology). Armstrong, Donald (Ed.) Springer 2009. ISBN 978-1-60761-322-0.</p> <p>Lipidomics and Bioactive Lipids: Mass Spectrometry Based Lipid Analysis, 1st Edition H. Alex Brown (Ed.). Elsevier, 2007.; ISBN-9780123738950</p>		
Supplementary literature	Publications on separation methods with MS detection and their use in omic research		
<b>Specialization learning outcomes</b>	<b>Learning outcomes</b>	<b>Learning outcomes reference symbols for the field</b>	
P-W01	Knows methods of biological sample preparation for analytical and omic determinations	K3-W07	
P-W02	Is familiar with and able to describe contemporary separation techniques: chromatographic and electromigratory	K3-W07; K3-W08	
P-W03	Knows research methodology used in classic analysis and in omic analysis	K3-W08	
P-W04	Demonstrates knowledge of concepts and practical uses of biostatistical assessment of research results	K3-W02	
P-U01	Is able to propose an analytical technique for solving a concrete scientific problem from the field of biomedical sciences	K3-U11	
P-U02	Is able to carry out metabolomics/lipidomic/proteomic analysis	K3-U12	
P-U03	Is able to interpret the obtained results on the basis of statistical methods	K3-U03	
P-K01	Is able to draw and formulate conclusions on the basis of research results and the acquired theoretical knowledge	K3-K06	
<b>Total student workload</b>	<b>Direct participation of the teacher:</b>		
	participation in seminars	2 x 3h	6h
	participation in classes	4 x 6h	24h
	participation in consultations connected with classes	1 x 1h	1h
		<b>TOTAL</b>	<b>31h</b>
	<b>Self-education</b>		
	preparation for classes	4 x 5h	20h
	preparation for seminars	2 x 3h	6h
	preparation for exams	1 x 30h	30h
		<b>TOTAL</b>	<b>56h</b>
		<b>Total</b>	<b>87h</b>
		<b>ECTS</b>	<b>3</b>
			<b>ECTS</b>
<b>Quantitative indicators</b>	Student workload: classes requiring direct participation of the teacher	31h	1
	Student workload: practical classes [24h+20h+20h]	64h	2
<b>Learning outcome code</b>	<b>Methods of learning outcome assessment</b>		
	<b>Formative</b>	<b>Summative</b>	
P-W01	Student assessment during seminars and classes	Exam	
P-W02	Student assessment during seminars and classes	Exam	
P-W03	Student assessment during seminars and classes	Exam	
P-W04	Student assessment during seminars and classes	Exam	
P-U01	Student assessment during seminars and classes	Exam	

P-U02	Student assessment during seminars and classes		Exam	
P-U03	Student assessment during seminars and classes		Exam	
P-U04	Student assessment during seminars and classes		Exam	
P-K01	Student assessment during seminars and classes		Exam	
<b><i>Course prepared on</i></b>	03.06.2016	<b><i>Course prepared by</i></b>	Prof. dr hab. E. Skrzydlewska	

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Faculty of Pharmacy with the Division of Laboratory Medicine						
Faculty	Doctoral studies in the field of pharmaceutical sciences		Qualification level and study mode	III cycle studies	full-time	
Course title	Advanced analytical techniques in omic research		ECTS points		1	
Department	Department of Inorganic and Analytical Chemistry		Course coordinator		Prof. dr hab. Elżbieta Skrzydlewska	
Course format	compulsory	4 <sup>th</sup> semester	Type of classes and no. of hours	lectures 0	classes 12h	seminars 3h
Course aim and objectives	Introducing doctoral students to the theory and use of advanced analytical techniques for assessing the effectiveness of pharmacotherapy.					
Course description	<p><b>seminars</b></p> <p>The use of advanced analytical techniques for assessing the effectiveness of rational pharmacotherapy. Separation techniques and analytical tools dedicated to proteomic, metabolomics, and lipidomic research, i.e. gas/liquid chromatography with mass spectrometry detection (TOF, QTOF, QOrbiTrap). Discussion of methods of sample preparation of biological material for individual determinations and limitations of the methodologies used.</p> <p><b>exercises</b></p> <p><i>Proteomics.</i> Isolation and quantitative analysis of proteins from biological samples with a complex matrix. Performing electrophoretic separation, in-gel protein digestion, and analysis of extracted peptides with separation by column chromatography and detection using an OrbiTrap mass spectrometer. Interpretation of results.</p> <p><i>Metabolomics.</i> Performing subsequent stages of the procedure of sample preparation of biological material for fingerprinting analysis with the use of the LC-QTOF technique. Isolation and quantitative analysis of proteins from biological samples with a complex matrix. Discussion of individual stages of processing of the obtained data taking into account elements of statistics and the types of final identification of metabolites (putative identification, using standards of chemical compounds and MS\MS spectra analysis).</p> <p><i>Lipidomics.</i> Isolation of the lipid fraction from biological material with the use of various methods. Quantitative assessment of phospholipid content in individual classes after prior separation with the use of the TLC technique. Obtaining the lipidomic profile for previously obtained extracts with the use of the LC-QTOF set. Identification of lipid compounds and interpretation of results. Performing target lipidomic analysis of selected lipid mediators.</p>					
Forms and methods of instruction	seminar with multimedia presentation and discussion laboratory classes					
Requirements and assessment	The classes end with assessment on the basis of evaluation of students' active participation in classes and evaluation of practical completion of classes.					
Basic literature	Witkiewicz Z.: Podstawy chromatografii. WNT, Warszawa 2005. Kamiński M.: Chromatografia cieczowa. Centrum Doskonałości Analityki i Monitoringu Środowiskowego, Gdańsk 2004 Kikkelsen S., Corton E. Bioanalytical chemistry, Wiley-Interscience, 2004 Metabolomics: Methods and Protocols (Methods in Molecular Biology). Weckwerth, Wolfram (Ed.). Springer 2007; ISBN 978-1-59745-244-1. Metabolomics, Metabonomics and Metabolite Profiling (RSC Publishing) Edited by William J. Griffiths. RSC, Cambridge 2008; ISBN 978-0-85404-299-9. Lipidomics Volume 1 2009 Methods and Protocols (Methods in Molecular Biology). Armstrong, Donald (Ed.) Springer 2009. ISBN 978-1-60761-322-0. Lipidomics and Bioactive Lipids: Mass Spectrometry Based Lipid Analysis, 1st Edition H. Alex Brown (Ed.). Elsevier, 2007.; ISBN-9780123738950					



Supplementary literature	Publications on the use advanced analytical techniques in omic research		
<b>Specialization learning outcomes</b>	<b>Learning outcomes</b>		<b>Learning outcomes reference symbols for the field</b>
P-W01	Knows methods of biological sample preparation for analytical and omic determinations		K3-W09
P-W02	Knows research methodology used in classic analysis and in omic analysis		K3-W10
P-W03	Demonstrates knowledge of concepts and practical uses of biostatistical assessment of research results		K3-W02
P-U01	Is able to carry out metabolomics/lipidomic/proteomic analysis		K3-U12
P-U02	Is able to interpret the obtained results on the basis of statistical methods		K3-U03, K3-U04
P-K01	Is able to draw and formulate conclusions on the basis of research results and the acquired theoretical knowledge		K3-K06
<b>Total student workload</b>	<b>Direct participation of the teacher:</b>		
	participation in seminars	1 x 3h	3h
	participation in classes	2 x 6h	12h
	participation in consultations connected with classes	1 x 1h	1h
		TOTAL	16h
	<b>Self-education</b>		
	preparation for classes	2 x 5h	10h
	preparation for seminars	1 x 3h	3h
		TOTAL	13h
		<b>Total</b>	<b>29h</b>
		<b>ECTS</b>	<b>1</b>
<b>Quantitative indicators</b>	Student workload: classes requiring direct participation of the teacher	16h	<b>ECTS</b> 1
	Student workload: practical classes	23h	1
<b>Learning outcome code</b>	<b>Methods of learning outcome assessment</b>		
	<b>Formative</b>	<b>Summative</b>	
P-W01	Student assessment during seminars and classes	assessment without final exam	
P-W02	Student assessment during seminars and classes	assessment without final exam	
P-W03	Student assessment during seminars and classes	assessment without final exam	
P-U01	Student assessment during seminars and classes	assessment without final exam	
P-U02	Student assessment during seminars and classes	assessment without final exam	
P-K01	Student assessment during seminars and classes	assessment without final exam	
<b>Course prepared on</b>	03.06.2016	<b>Course prepared by</b>	Prof. dr hab. E. Skrzydlewska

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