



## Syllabus of the discipline "Methodology of research in toxicological and forensic chemistry on the topic of the master's thesis"

<b>1. General information</b>	
<b>Faculty</b>	Pharmacy
<b>Educational program</b>	22 Healthcare, 226 Pharmacy, second (master's) level of higher education, full-time
<b>Name of discipline, code</b>	Methodology of scientific research in toxicological and forensic chemistry on the topic of master's thesis; ББ3.6; <a href="http://new.meduniv.lviv.ua/">http://new.meduniv.lviv.ua/</a>
<b>Department</b>	Toxicological and Analytical Chemistry; 79010, Lviv, Pekarska str. 69 phone: +38 (032) 368437, Kaf toxchemistry@meduniv.lviv.ua
<b>Head of department</b>	Halkevych Irene, PhD, associated professor, <a href="mailto:irynga.galkevych@gmail.com">irynga.galkevych@gmail.com</a>
<b>Year of study</b>	5th year
<b>Semester</b>	10th semester
<b>Type of discipline / module</b>	elective
<b>Lecturers</b>	Yu. I. Bidnychenko, PhD, assoc.prof., <a href="mailto:bidnyuri@i.ua">bidnyuri@i.ua</a> ; S. Yu. Kramarenko, PhD, senior lect., <a href="mailto:sergeikr@gmail.com">sergeikr@gmail.com</a> ; L. I. Osypchuk, PhD, assist.prof. <a href="mailto:osipshukl@gmail.com">osipshukl@gmail.com</a> ; S.I. Davydovych, PhD, assist.prof., <a href="mailto:ihlitska.sophia@gmail.com">ihlitska.sophia@gmail.com</a>
<b>Erasmus</b>	No
<b>The person responsible for the syllabus</b>	Assist.prof. Osypchuk Lyudmyla <a href="mailto:osipshukl@gmail.com">osipshukl@gmail.com</a>
<b>Number of ECTS credits</b>	15 credits ECTS
<b>Number of hours</b>	Lectures – 4 hours; practice – 26 hours; students individual work – 420 hours
<b>Language learning</b>	English
<b>Information about consultations</b>	Consultations at the department take place in accordance with the approved schedule of consultations.
<b>Address, telephone and regulations of the clinical base, office</b>	

### 2. Short annotation to the course

The course "Methodology of research in toxicological and forensic chemistry on the topic of master's thesis" is aimed at highlighting the theoretical knowledge and developing students' practical skills for scientific research.

Students learn to use general search engines and specialized databases to conduct patent information search when planning research and analyze information obtained during the search and experiment. Considerable attention is paid to the study of basic approaches to the development of methods for establishing identity, identification and quantification of substances by modern chromatographic and spectral methods of analysis. Students get acquainted with the basic rules and procedures for final qualification (master's) work.

### 3. The purpose and objectives of the course

The purpose of teaching the course "Methodology of research in toxicological and forensic chemistry on the topic of master's work" is to provide students with skills in planning and conducting research in accordance with current legislation of Ukraine and GLP principles, registration of results in the form of scientific papers and final qualification (master's) work.

The main objectives of the course "Methodology of research in toxicological and forensic chemistry on the topic of the master's thesis":

- mastering knowledge of research methodology;
- ability to search and process scientific information;
- forming skills of planning, organizing and conducting research, documenting and statistical processing of primary data;
- study of the main approaches to the development of methods for establishing the identity, identification and quantification of substances by modern chromatographic and spectral methods of analysis;
- ability to scientifically interpret the obtained results;
- obtaining knowledge related to writing and competent design of the final qualification (master's) thesis.

### 4. Course details

Course of the discipline "Methodology of scientific research in toxicological and forensic chemistry on the topic of master's thesis":

a) is based on knowledge of inorganic chemistry, bioinorganic, physical and colloid chemistry, organic and bioorganic chemistry, analytical chemistry, biological chemistry, pharmaceutical chemistry, toxicological and forensic chemistry, botany and pharmacognosy, pharmacology and pharmacotherapy, clinical biology, medicine, basics of higher mathematics, statistics and computer science, drug technology, organization and economics of pharmacy, anatomy, normal and pathological physiology and integrates with these disciplines;

b) lays the foundations of knowledge, skills and abilities for writing qualification (master's) work and work in the field of chemical-toxicological, forensic-toxicological and sanitary-hygienic research.

### 5. Program learning outcomes

#### List of learning outcomes

Learning outcome code	The content of the learning outcome	Reference to the code of the competence matrix
3H-1	Have specialized conceptual knowledge acquired in the learning process.	III-1, 4, 13, 23
3H-2	Have deep knowledge of the structure of professional activity.	III-2, 10, 15, 25
3H-3	Know the methods of analysis, synthesis and further modern learning.	III-5, 6, 7
3H-4	Have in-depth knowledge in the field of information and communication technologies used in professional activities	III-8, 9, 12, 29
3H-5	Know the methods of evaluating performance indicators	III-11, 20, 31
3H-6	Know the components of the health care system, planning and evaluating research.	III-22, 24, 30
3H-7	Know the problems of environmental protection and ways to preserve it.	III-3, 28
3H-8	Know the modern requirements for the organization and provision of chemical and toxicological analysis, forensic toxicological and preclinical studies.	III-20, 22
3H-9	Know the ways of entry of toxins into the body and excretion from the body, their toxicokinetics, distribution in the body.	III-14, 16
3H-10	Know the theoretical foundations of methods for determining toxicity and other safety parameters of substances. Know the	III-17, 19

<i>3H-11</i>	classification of poisons and poisonings; mechanisms of toxic action of poisons. Know the basic requirements for the plan of forensic toxicology and preclinical studies. Know on the basis of which actions, procedures and documents the research plan is made.	<i>ПП-24, 31</i>
<i>3H-12</i>	Know the chemical and modern instrumental methods of analysis, specificity and sensitivity of different research methods.	<i>ПП-26, 27</i>
<i>3H-13</i>	Know the basics of poison isolation from various objects of study.	<i>ПП-18</i>
<i>3H-14</i>	Know the standard procedures of statistical analysis.	<i>ПП-32</i>
<i>УМ-1</i>	Be able to solve complex problems and problems that arise in professional activities.	<i>ПП-1, 4, 13, 23</i>
<i>УМ-2</i>	Be able to carry out professional activities that require updating and integration of knowledge	<i>ПП-2, 10, 15, 25</i>
<i>УМ-3</i>	Be able to analyze information, make informed decisions, be able to acquire modern knowledge.	<i>ПП-5, 6, 7</i>
<i>УМ-4</i>	Be able to use information and communication technologies in the professional field, which requires updating and integration of knowledge.	<i>ПП-8, 9, 12, 29</i>
<i>УМ-5</i>	Be able to ensure quality work.	<i>ПП-11, 20, 31</i>
<i>УМ-6</i>	Search for scientific sources of information; to make a choice of methods of carrying out scientific research. Use methods of mathematical analysis and modeling, theoretical analysis and modeling, theoretical and experimental research in pharmacy.	<i>ПП-22, 24, 30</i>
<i>УМ-7</i>	Be able to form requirements for themselves and others to preserve the environment.	<i>ПП-3, 28</i>
<i>УМ-8</i>	Be able to organize and conduct chemical and toxicological analysis, forensic toxicological and preclinical studies.	<i>ПП-20, 22</i>
<i>УМ-9</i>	Be able to choose objects of study to study the distribution in tissues and kinetics of substances ;. to predict the main directions of metabolism of substances on the basis of their chemical structure.	<i>ПП-14, 16</i>
<i>УМ-10</i>	Be able to organize research to determine different types of toxicity and safety of test substances. Be able to make a differential diagnosis of acute poisoning and predict possible mechanisms of toxic effects of poisons.	<i>ПП-17, 19</i>
<i>УМ-11</i>	Be able to make a plan and choose the optimal course of forensic toxicology and preclinical studies guided by relevant regulations.	<i>ПП-24, 31</i>
<i>УМ-12</i>	Be able to choose research methods for different groups of poisons and for different objects of research, as well as to prepare reagents for analysis; work with modern laboratory equipment.	<i>ПП-26, 27</i>
<i>УМ-13</i>	Be able to excrete toxins from the internal organs of animals, blood and urine.	<i>ПП-18</i>
<i>УМ-14</i>	Be able to justify the sample size, apply methods of statistical analysis, provide the results of statistical data processing	<i>ПП-32</i>
<i>К-1</i>	Ability to apply knowledge in practical situations.	<i>ПП-1, 4, 13, 23</i>
<i>К-2</i>	Knowledge and understanding of the subject area and understanding of the profession.	<i>ПП-2, 10, 15, 25</i>
<i>К-3</i>	Ability to abstract thinking, analysis and synthesis, the ability to learn and be modernly trained.	<i>ПП-5, 6, 7</i>
<i>К-4</i>	Skills in the use of information and communication	<i>ПП-8, 9, 12, 29</i>

<i>K-5</i>	technologies.	<i>PIP-11, 20, 31</i>
<i>K-6</i>	Ability to evaluate and ensure the quality of work performed.	<i>PIP-22, 24, 30</i>
<i>K-7</i>	Ability to conduct research at the appropriate level.	<i>PIP-3, 28</i>
<i>K-8</i>	The desire to preserve the environment.	<i>PIP-20, 22</i>
<i>K-9</i>	Ability to organize, provide and conduct chemical and toxicological analysis, forensic toxicological and preclinical studies.	<i>PIP-14, 16</i>
<i>K-10</i>	Ability to correctly select the objects of study in the study of tissue distribution and kinetics of substances ;.	<i>PIP-17, 19</i>
<i>K-11</i>	Ability to study different types of toxicity of substances in laboratory animals. Ability to differentially diagnose acute poisoning and predict possible mechanisms of toxic action of poisons.	<i>PIP-24, 31</i>
<i>K-12</i>	Ability to properly draw up a plan for forensic toxicology and preclinical studies guided by relevant regulations.	<i>PIP-26, 27</i>
<i>K-13</i>	Ability to determine the list of equipment and reagents for specific forensic toxicological and chemical toxicological studies and the manufacture of reagents for analysis.	<i>PIP-18</i>
<i>K-14</i>	Skills of excretion of poisons from internal organs of animals, blood and urine. Ability to interpret and evaluate the results of forensic toxicological and chemical toxicological studies	<i>PIP-32</i>
<i>AB-1</i>	Responsible for making decisions in difficult conditions.	<i>PIP-1, 4, 13, 23</i>
<i>AB-2</i>	To be responsible for professional development, ability to further professional training with a high level of autonomy.	<i>PIP-2, 10, 15, 25</i>
<i>AB-3</i>	Be responsible for the timely acquisition of modern knowledge.	<i>PIP-5, 6, 7</i>
<i>AB-4</i>	Be responsible for the development of professional knowledge and skills.	<i>PIP-8, 9, 12, 29</i>
<i>AB-5</i>	Be responsible for the quality of work.	<i>PIP-11, 20, 31</i>
<i>AB-6</i>	Be responsible for the development and implementation of planned projects.	<i>PIP-22, 24, 30</i>
<i>AB-7</i>	Be responsible for the implementation of environmental protection measures within its competence.	<i>PIP-3, 28</i>
<i>AB-8</i>	Be responsible for the organization, provision and conduct of chemical and toxicological analysis, forensic toxicological and preclinical studies.	<i>PIP-20, 22</i>
<i>AB-9</i>	Be responsible for deciding on the choice of research objects for each specific research	<i>PIP-14, 16</i>
<i>AB-10</i>	Be responsible for deciding on the toxicity and safety of test substances.	<i>PIP-17, 19</i>
<i>AB-11</i>	Be responsible for drawing up a plan for forensic toxicology and preclinical studies.	<i>PIP-24, 31</i>
<i>AB-12</i>	Be responsible for deciding on the list of equipment and reagents for specific forensic toxicological and chemical toxicological studies and the quality of reagents produced for analysis.	<i>PIP-26, 27</i>
<i>AB-13</i>	To be responsible for the validity of the developed methods of isolation of poisons from the objects of research and methods of qualitative and quantitative analysis.	<i>PIP-18</i>
<i>AB-14</i>	Be responsible for the results of chemical and toxicological analysis and forensic chemical research.	<i>PIP-32</i>
<b>6. Course format and scope</b>		

<b>Course format</b>	full-time course		
<b>Type of classes</b>	<b>Number of hours</b>	<b>Number of groups</b>	
Lectures	4	1	
Practice	26		
Seminars	–		
Individual work	420		
<b>7. Topics and content of the course</b>			
<b>Code type classes</b>	<b>Topic</b>	<b>Learning content</b>	<b>Code of study results</b>
JI-1 2 hours	Scientific knowledge and its methodology. Classification of methods of scientific knowledge and their characteristics. Synthesis and analysis as the main ways of cognition. Theoretical and experimental methods of research. The concept of types of observations and experiments. Basic approaches to planning experiments and observations. Ways to find patterns based on the obtained empirical data.	Scientific knowledge and its methodology. Classification of methods of scientific knowledge and their characteristics. Synthesis and analysis as the main ways of cognition. Theoretical and experimental research methods. The concept of types of observations and experiments. Basic approaches to experiment planning and observations. Ways to find patterns based on the obtained empirical data.	<i>3H 1-14</i> <i>YM 1-14</i> <i>K 1-14</i> <i>AB 1-14</i>
JI-2 2 hours	Planning and procedure for conducting research. Basic approaches to patent information search in scientific research. Search for information in the patent databases of the EU, USA, Japan and China. Use of general search engines and search of information in specialized databases. Approaches to the processing of information obtained in the process of search and experiment, its impact on the further	Planning and procedure for conducting research. Basic approaches to patent information search in scientific research. Search for information in the patent databases of the EU, USA, Japan and China. Use of general search engines and search of information in specialized databases. Approaches to the processing of information obtained in the process of search and experiment, its impact on the further implementation of research, evaluation and processing of information obtained.	<i>3H 1-14</i> <i>YM 1-14</i> <i>K 1-14</i> <i>AB 1-14</i>

	implementation of research, evaluation and processing of information obtained.		
II-1 2 hours	The main factors that should be considered when planning a research. Structure and procedure of scientific research. Methodological approaches to assessing the relevance of the topic and setting tasks for scientific work. Search for general information on the use, pharmacological and toxicological properties of substances on the Internet.	The main factors that should be considered when planning a research. Structure and procedure of scientific research. Methodological approaches to assessing the relevance of the topic and setting tasks for scientific work. Search for general information on the use, pharmacological and toxicological properties of substances on the Internet.	<i>ЗН-1, 8, 10, 13</i> <i>УМ-1, 8, 10, 13</i> <i>К-1, 8, 10, 13</i> <i>АВ-1, 8, 10, 13</i>
II-2 2 hours	Search for information on the topic of scientific work in patent databases, reports on side effects, prohibitions on use and search for sources with reports of poisoning, non-medical use, etc.	Search for information on the topic of scientific work in patent databases, reports on side effects, prohibitions on use and search for sources with reports of poisoning, non-medical use, etc.	<i>ЗН-2, 7, 9</i> <i>УМ-2, 7, 9</i> <i>К-2, 7, 9</i> <i>АВ-2, 7, 9</i>
II-3 2 hours	Search for information on the topic of scientific work in scientific journals. Ukrainian journals and information resources where you can find information on methods of analysis and toxic properties of various substances. The procedure for searching for information in the databases of abstract articles in foreign journals. Resources for access to the full text of articles in	Search for information on the topic of scientific work in scientific journals. Ukrainian journals and information resources where you can find information on methods of analysis and toxic properties of various substances. The procedure for searching for information in the databases of abstract articles in foreign journals. Resources for access to the full text of articles in foreign journals and other scientific and reference materials.	<i>ЗН-1, 9</i> <i>УМ-1, 9</i> <i>К-1, 9</i> <i>АВ-1, 9</i>



	foreign journals and other scientific and reference materials.		
II-4 2 hours	<p>Objects of analysis, their main types and influence on the choice of methodology and method of analysis. The concept of matrix effect and methods of taking into account, reducing and / or eliminating the errors of analysis caused by it. Features of analysis of substances in biological matrices. Methodical approaches for choosing a method of isolating toxicologically important substances from biological material and evaluating its effectiveness.</p>	<p>Objects of analysis, their main types and influence on the choice of methodology and method of analysis. The concept of matrix effect and methods of taking into account, reducing and / or eliminating the errors of analysis caused by it. Features of analysis of substances in biological matrices. Methodical approaches for choosing a method of isolating toxicologically important substances from biological material and evaluating its effectiveness.</p>	<p><i>ЗН-3, 10</i> <i>УМ-3, 10</i> <i>К-3, 10</i> <i>АВ-3, 10</i></p>
II-5 2 hours	<p>The main methods of separation and concentration, which are widely used in chemical analysis for cleaning and preparation of samples, their main characteristics and features of use. Approaches to the selection of optimal methods and conditions of sample cleaning depending on the properties of the studied substances, the method of isolation, the method of analysis and other factors.</p>	<p>The main methods of separation and concentration, which are widely used in chemical analysis for cleaning and preparation of samples, their main characteristics and features of use. Approaches to the selection of optimal methods and conditions of sample cleaning depending on the properties of the studied substances, the method of isolation, the method of analysis and other factors.</p>	<p><i>ЗН-2, 9</i> <i>УМ-2, 9</i> <i>К-2, 9</i> <i>АВ-2, 9</i></p>
II-6 2 hours	<p>Use of optical methods for identification and quantification of substances. The</p>	<p>Use of optical methods for identification and quantification of substances. The procedure for developing methods of identification and confirmation of identity by UV and IR spectroscopy. Approaches for the development</p>	<p><i>ЗН-4, 10</i> <i>УМ-4, 10</i> <i>К-4, 10</i> <i>АВ-4, 10</i></p>

	<p>procedure for developing methods of identification and confirmation of identity by UV and IR spectroscopy.</p> <p>Approaches for the development of methods for quantitative determination of substances in samples by UV spectrophotometry, spectrometry in the visible region and photocolourimetry.</p>	<p>of methods for quantitative determination of substances in samples by UV spectrophotometry, spectrometry in the visible region and photocolourimetry.</p>	
<p>II-7 2 hours</p>	<p>Review and characteristics of chromatographic methods used in chemical analysis. The main approaches to the development of methods for the identification of substances by chromatography in a thin layer of sorbent. The main stages of development of gas chromatography techniques to confirm the identity, identification and quantification of substances.</p>	<p>Review and characteristics of chromatographic methods used in chemical analysis. The main approaches to the development of methods for the identification of substances by chromatography in a thin layer of sorbent. The main stages of development of gas chromatography techniques to confirm the identity, identification and quantification of substances.</p>	<p><i>3H-1, 10, 12</i> <i>VM-1, 10, 12</i> <i>K-1, 10, 12</i> <i>AB-1, 10, 12</i></p>
<p>II-8 2 hours</p>	<p>Basic approaches to the development of methods for identification, identification and quantification of substances by high performance liquid chromatography. Features of using high performance liquid chromatography for enantiomer analysis.</p>	<p>Basic approaches to the development of methods for identification, identification and quantification of substances by high performance liquid chromatography. Features of using high performance liquid chromatography for enantiomer analysis.</p>	<p><i>3H-9, 10, 13</i> <i>VM-9, 10, 13</i> <i>K-9, 10, 13</i> <i>AB-9, 10, 13</i></p>
<p>II-9 2 hours</p>	<p>Basic electromigration methods used in chemical analysis.</p>	<p>Basic electromigration methods used in chemical analysis. Procedure for developing methods for substance identification by paper electrophoresis and gel electrophoresis. Review</p>	<p><i>3H-1, 7, 10</i> <i>VM-1, 7, 10</i> <i>K-1, 7, 10</i> <i>AB-1, 7, 10</i></p>



	<p>Procedure for developing methods for substance identification by paper electrophoresis and gel electrophoresis.</p> <p>Review of methods of using capillary band electrophoresis in the analysis. Methodical approaches to the development of methods for identification, identification and quantification of substances by capillary band electrophoresis, features of the use of enantioselective additives to the electrolyte.</p>	<p>of methods of using capillary band electrophoresis in the analysis. Methodical approaches to the development of methods for identification, identification and quantification of substances by capillary band electrophoresis, features of the use of enantioselective additives to the electrolyte.</p>	
<p>II-10 2 hours</p>	<p>Review of basic techniques of mass spectrometry. Methodical approaches to the use of this method to establish the structure of substances, their identification and confirmation of identity. Basic libraries of mass spectra, programs of work with them and principles of work of these programs.</p>	<p>Review of basic techniques of mass spectrometry. Methodical approaches to the use of this method to establish the structure of substances, their identification and confirmation of identity. Basic libraries of mass spectra, programs of work with them and principles of work of these programs.</p>	<p><i>3H-2, 10</i> <i>YM-2, 10</i> <i>K-2, 10</i> <i>AB-2, 10</i></p>
<p>II-11 2 hours</p>	<p>Evaluation and interpretation of research results obtained by different methods. Analysis of their compliance with the objectives of the study. The value of negative results. Methodical approaches to assessing the adequacy of the obtained results and</p>	<p>Evaluation and interpretation of research results obtained by different methods. Analysis of their compliance with the objectives of the study. The value of negative results. Methodical approaches to assessing the adequacy of the obtained results and establishing the need for clarifying research.</p>	<p><i>3H-9, 7, 12</i> <i>YM-9, 7, 12</i> <i>K-9, 7, 12</i> <i>AB-9, 7, 12</i></p>

	establishing the need for clarifying research.		
II-12 2 hours	The main methodological approaches to the generalization of the obtained research results. The procedure and features of statistical processing of experimental data, calculations of metrological characteristics of analysis methods for their validation and formulation on the basis of these characteristics of conclusions about the suitability of analytical methods, features of their use, etc. Use of specialized programs for statistical and other calculations.	The main methodological approaches to the generalization of the obtained research results. The procedure and features of statistical processing of experimental data, calculations of metrological characteristics of analysis methods for their validation and formulation on the basis of these characteristics of conclusions about the suitability of analytical methods, features of their use, etc. Use of specialized programs for statistical and other calculations.	<i>3H-2, 7, 9, 10</i> <i>YM-2, 7, 9, 10</i> <i>K-2, 7, 9, 10</i> <i>AB-2, 7, 9, 10</i>
II-13 4 hours	Regulations on final qualifying work, basic rules and procedures for registration of the results of scientific work. Types and systems of bibliographic references, UDC, basic documents governing them and programs and services of the Internet for their design. Registration of results of scientific work by means of word processors, specialized graphic editors and other programs. Basic requirements for the presentation and the order of their creation.	Regulations on final qualifying work, basic rules and procedures for registration of the results of scientific work. Types and systems of bibliographic references, UDC, basic documents governing them and programs and services of the Internet for their design. Registration of results of scientific work by means of word processors, specialized graphic editors and other programs. Basic requirements for the presentation and the order of their creation.	<i>3H-1, 6, 14</i> <i>YM-1, 6, 14</i> <i>K-1, 6, 14</i> <i>AB-1, 6, 14</i>

SIW-	The main factors to consider when planning a research. Structure and	<i>3H-1, 8, 10, 13</i>
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1	procedure of scientific research. Methodological approaches to assessing the relevance of the topic and setting tasks for scientific work. Search for general information on the use, pharmacological and toxicological properties of substances on the Internet.	<i>УМ-1, 8, 10, 13</i> <i>К-1, 8, 10, 13</i> <i>АВ-1, 8, 10, 13</i>
SIW-2	Search for information on the topic of scientific work in patent databases, reports on side effects, prohibitions on use and search for sources with reports of poisoning, non-medical use, etc.	<i>ЗН-2, 7, 9</i> <i>УМ-2, 7, 9</i> <i>К-2, 7, 9</i> <i>АВ-2, 7, 9</i>
SIW-3	Search for information on the topic of scientific work in scientific journals. Ukrainian journals and information resources where you can find information on methods of analysis and toxic properties of various substances. The procedure for searching for information in the databases of abstract articles in foreign journals. Resources for access to the full text of articles in foreign journals and other scientific and reference materials.	<i>ЗН-1, 9</i> <i>УМ-1, 9</i> <i>К-1, 9</i> <i>АВ-1, 9</i>
SIW-4	Objects of analysis, their main types and influence on the choice of methodology and method of analysis. The concept of matrix effect and methods of taking into account, reducing and / or eliminating the errors of analysis caused by it. Features of analysis of substances in biological matrices. Methodical approaches for choosing a method of isolating toxicologically important substances from biological material and evaluating its effectiveness.	<i>ЗН-3, 10</i> <i>УМ-3, 10</i> <i>К-3, 10</i> <i>АВ-3, 10</i>
SIW-5	The main methods of separation and concentration, widely used in chemical analysis for cleaning and preparation of samples, their main characteristics and features of use. Approaches to the selection of optimal methods and conditions for cleaning samples depending on the properties of the test substances, the method of isolation, the method of analysis and other factors.	<i>ЗН-2, 9</i> <i>УМ-2, 9</i> <i>К-2, 9</i> <i>АВ-2, 9</i>
SIW-6	Use of optical methods for identification and quantification of substances. The procedure for developing methods of identification and confirmation of identity by UV and IR spectroscopy. Approaches for the development of methods for quantitative determination of substances in samples by UV spectrophotometry, spectrometry in the visible region and photolorimetry.	<i>ЗН-4, 10</i> <i>УМ-4, 10</i> <i>К-4, 10</i> <i>АВ-4, 10</i>
SIW-7	Review and characteristics of chromatographic methods used in chemical analysis. The main approaches to the development of methods for the identification of substances by chromatography in a thin layer of sorbent. The main stages of development of gas chromatography techniques to confirm the identity, identification and quantification of substances.	<i>ЗН-1, 10, 12</i> <i>УМ-1, 10, 12</i> <i>К-1, 10, 12</i> <i>АВ-1, 10, 12</i>
SIW-8	Basic approaches to the development of methods for identification, identification and quantification of substances by high performance liquid chromatography. Features of using high performance liquid chromatography for enantiomer analysis.	<i>ЗН-9, 10, 13</i> <i>УМ-9, 10, 13</i> <i>К-9, 10, 13</i> <i>АВ-9, 10, 13</i>
SIW-9	Basic electromigration methods used in chemical analysis. Procedure for developing methods for substance identification by paper electrophoresis and gel electrophoresis. Review of methods of using capillary band electrophoresis in the analysis. Methodical approaches to the development of methods for identification, identification and quantification of substances by capillary band electrophoresis, features of the use of enantioselective additives to the electrolyte.	<i>ЗН-1, 7, 10</i> <i>УМ-1, 7, 10</i> <i>К-1, 7, 10</i> <i>АВ-1, 7, 10</i>
SIW	Review of basic techniques of mass spectrometry. Methodical	<i>ЗН-2, 10</i>

-10	approaches to the use of this method to establish the structure of substances, their identification and confirmation of identity. Basic libraries of mass spectra, programs of work with them and principles of work of these programs.	<i>УМ-2, 10</i> <i>К-2, 10</i> <i>АВ-2, 10</i>
SIW-11	Evaluation and interpretation of research results obtained by different methods. Analysis of their compliance with the objectives of the study. The value of negative results. Methodical approaches to assessing the adequacy of the obtained results and establishing the need for clarifying research.	<i>ЗН-9, 7, 12</i> <i>УМ-9, 7, 12</i> <i>К-9, 7, 12</i> <i>АВ-9, 7, 12</i>
SIW-12	The main methodological approaches to the generalization of the obtained research results. The procedure and features of statistical processing of experimental data, calculations of metrological characteristics of analysis methods for their validation and formulation on the basis of these characteristics of conclusions about the suitability of analytical methods, features of their use, etc. Use of specialized programs for statistical and other calculations.	<i>ЗН-2, 7, 9, 10</i> <i>УМ-2, 7, 9, 10</i> <i>К-2, 7, 9, 10</i> <i>АВ-2, 7, 9, 10</i>
SIW-13	Regulations on final qualifying work, basic rules and procedures for registration of the results of scientific work. Types and systems of bibliographic references, UDC, basic documents governing them and programs and services of the Internet for their design. Registration of results of scientific work by means of word processors, specialized graphic editors and other programs. Basic requirements for the presentation and the order of their creation.	<i>ЗН-1, 6, 14</i> <i>УМ-1, 6, 14</i> <i>К-1, 6, 14</i> <i>АВ-1, 6, 14</i>
The lectures use a multimedia presentation; in practical classes - handouts and teaching materials, laboratory equipment, to test the acquired knowledge and skills - test and calculation tasks, for independent work provided a list of necessary literature sources.		

## 8. Verification of learning results

### Current control

Code of study results	Code type classes	Method of verifying learning results	Enrollment criteria
<i>ЗН 1-14</i> <i>УМ 1-14;</i> <i>К 1-14</i> <i>АВ 1-14</i>	<i>Л 1-2;</i> <i>П 1-13;</i> <i>СРС 1-35</i>	Current control is carried out at each practical lesson. The following means of control of level of preparation of students are applied: - oral examination and written assignments, - solving situational problems, - control of practical skills. Forms of current control: theoretical knowledge - individual surveys, interviews; practical skills and abilities - solving typical and situational problems and control of practical actions. The student's independent work is assessed during the current control of the topic in the relevant classroom.	At each lesson, the level of students' knowledge is assessed on a 4-point scale: <b>Excellent ("5").</b> The student correctly, clearly, logically and fully answers the standardized questions of the current topic, including questions of independent work. Closely connects theory with practice and correctly demonstrates the performance (knowledge) of practical skills. Freely solves situational problems of increased complexity, is able to summarize the material. <b>Good ("4").</b> The student correctly and essentially answers the standardized questions of the current topic, independent work. Demonstrates performance (knowledge) of practical skills. Correctly uses theoretical knowledge in solving practical problems. Is able

		<p>to solve easy and medium situational problems. Has the necessary practical skills and techniques to perform them in excess of the required minimum.</p> <p><b>Satisfactory ("3").</b> The student incompletely, with the help of additional questions, answers the standardized questions of the current topic, lecture course and independent work. Cannot build a clear, logical answer on their own. During the answer and demonstration of practical skills the student makes mistakes. The student solves only the easiest problems, has only a mandatory minimum of research methods.</p> <p><b>Unsatisfactory ("2").</b> The student does not know the material on the exact topic, can not build a logical answer, does not answer additional questions, does not understand the content of the material. Makes significant, gross mistakes when answering and demonstrating practical skills.</p>
<p>The maximum number of points that a student can receive for the current activity is 200 points. The minimum number of points that a student can score for the current activity for the test is 120 points.</p> <p>The calculation of the number of points is based on the grades obtained by the student on the traditional scale during the study of the discipline, by calculating the arithmetic mean (CA), rounded to two decimal places. The average score for current activities is converted into a 200-point scale.</p>		

### Final control

The form of final control of study in the course "Methodology of research in toxicological and forensic chemistry on the topic of master's thesis" is a test, which is given to a student who has completed all types of work provided by the curriculum, completed all classes and scored a point not less than the minimum.

Discipline scores for students who have successfully completed the program are converted into a traditional 4-point scale according to the absolute criteria, which are given in the table below:

Points in the discipline	Score on a 4-point scale
From 170 to 200 points	5
From 140 to 169 points	4
From 139 points to the minimum number of points that a student must score	3
Below the minimum number of points that a student must score	2

The course "Methodology of research in toxicological and forensic chemistry on the topic of master's thesis" ends with the implementation of a master's thesis, which is assessed by an objective structured practical (clinical) exam.

#### Criteria for evaluating the master's thesis

The grade for the master's thesis is based on the assessment of the level of performance and the level of protection of the master's thesis and is determined by the traditional 4-point scale (5 - "excellent", 4 - "good", 3 - "satisfactory", 2 - "unsatisfactory").

The final grade for the master's thesis is determined by a multi-point (200-point) scale, the traditional 4-point scale and the ECTS rating scale.

The calculation of the number of points on a 200-point system is based on the obtained grades for the performance and defense of the master's thesis by calculating the arithmetic mean (CA). The value obtained is converted into points on a 200-point scale as follows:  $X = CA \cdot 200/5$

The maximum number of points that a student can score in the defense of final qualifying work is 200 points.

Minimum number of points which must be scored by the student to defend the final qualifying work 100 points.

The calculation of the number of points for master's thesis in a 200-point scale is converted into a 4-point scale: from 180 to 200 points - 5 "excellent", from 140 to 179 points - 4 "good", from 101 to 139 points - 3 "satisfactory", 100 points and less - 2 "unsatisfactory"

### 9. Course policy

In the process of studying the specialization "Methodology of scientific research in toxicological and forensic chemistry on the topic of master's thesis" the following methods of teaching students are used:

- by sources of knowledge: verbal (lecture, explanation, instruction); visual (demonstration, illustration); practical (practical work, situational tasks);
- by the nature of the logic of cognition: analytical, synthetic, analytical-synthetic, inductive, deductive;
- by the level of independent mental activity: problem, partial-search, research;
- the main stages of the process: the formation of knowledge, the formation of skills and abilities, the application of knowledge, generalization, consolidation, verification;
- according to the system approach: stimulation and motivation, control and self-control.

### 10. Reference

#### Obligatory

1. Harding S. Objectivity and Diversity: Another Logic of Scientific Research. – University of Chicago Press, 2015. – 232 p.
2. Deetjen T. Published: a guide to literature review, outlining, experimenting, visualization, writing, editing, and peer review for your first scientific journal article. – Productive Academic,



2020. – 276 p.

3. Kelly M. A., Haddix P. L. The Fundamentals of Scientific Research. An Introductory Laboratory Manual. – Wiley-Blackwell, 2015. – 208 p.
4. Food, Drug Administration Centre for Drug Evaluation and Research (FDA). Guidance for industry-bioanalytical method validation, center for drug evaluation and research. US Department for Health and Human Services, 2013, Silver Spring, MD, 2001.
5. Guideline on bioanalytical method validation. European Medicines Agency (EMA/CHMP/EWP/192217/2009), 2011.
6. Handbook of Toxicology. 2 ed. / Edited by Derelanko M.J., Hollinger\_M.A. - N.W.: CRC Press LLC, 2002. 1380 p.
7. Moffat A. C., Osselton M. D., Widdop B. Clarke's analysis of drugs and poisons. London: Pharmaceutical Press, 2011. 2609 p
8. Poisoning and Drug Overdose. Fifth Edition / Edited by Kent R. Olson. - San Francisco: The McGraw-Hill Companies, 2007. 1132 p.
9. Randall C. Baselt. Disposition of Toxic Drugs and Chemicals in Man. – California, Foster City; Chemical Toxicology Institute, 2000. 920 p.

#### **Additional**

1. Foong May Yeong. How To Read And Critique A Scientific Research Article Notes To Guide Students Reading Primary Literature. – Wspc, 2014. – 116 p.
2. Mamishev A. Creating Research and Scientific Documents with Microsoft Word. – Microsoft Press, 2013. – 284 p.
3. Wilson E. B. An Introduction to Scientific Research. – Dover Publications, Inc., 2003. – 400 p.
4. Koepsell D. Scientific Integrity and Research Ethics: An Approach from the Ethos of Science. – Springer, 2017. – 129 p.

#### **11. Equipment, logistics and software of the discipline / course**

Computer and multimedia projector; teaching materials, test and calculation tasks, laboratory equipment and apparatus.

#### **12. Additional information**

Responsible for the scientific group of the department – PhD, assist.prof Darmogray N.M, [darnatlviv@gmail.com](mailto:darnatlviv@gmail.com)

Regulations on the preparation and defense of final qualification work by students of the Faculty of Pharmacy of Danylo Halytskyi Lviv National Medical University [http://old.meduniv.lviv.ua/files/datest/polozhennya\\_pro\\_vkr.pdf](http://old.meduniv.lviv.ua/files/datest/polozhennya_pro_vkr.pdf)

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