



A syllabus of discipline «Metabolism of drugs»

1. General information	
Name of the faculty	Faculty of foreign studenti
Educational program (branch, specialty, higher education level, form of education)	22 «Health care» in the specialty 226 “Pharmacy”, of the second (master’s) level of higher education in the field of knowledge
Academic year	2021/2022
Name of the discipline, code <i>(email address at Danilo Halytsky Lviv National Medical University)</i>	Metabolism of drugs OK 12 Kaf_biochemistry@meduniv.lviv.ua
Department <i>(name, address, telephone, e-mail)</i>	Department of Biological Chemistry, address Pekarska str., 69, Lviv, Ukraine, 79010, phone: +38 (032) 275 76 02, e-mail: Kaf_biochemistry@meduniv.lviv.ua
Head of the department <i>(contact e-mail)</i>	Sklyarov Oleksandr Yakovych - MD, Doctor of Medical Sciences, Professor e-mail: o.y.sklyarov@gmail.com
Year of study <i>(year of study of discipline)</i>	Third year
Semester <i>(semester in which discipline is being implemented)</i>	6 semester
Type of discipline / module <i>(required / optional)</i>	Optional
Tutors <i>(names, degrees and titles of teachers who teach discipline, contact e-mail)</i>	Fomenko Iryna Stepanivna, Doctir of Biological Sciences, Professor, e-mail: iryna.fomenko.lviv@gmail.com.ua
Erasmus yes / no <i>(discipline availability for students at within the Erasmus + program)</i>	No
The person responsible for the syllabus <i>(e-mail)</i>	Fomenko I.S, Doctir of Biological Sciences, Professor, e-mail: iryna.fomenko.lviv@gmail.com.ua
Number of ECTS credits	3 credits
Number of hours <i>(lectures/practical classes/self-educational work of students)</i>	90 hours (10/20/60)
Language of teaching	English
Consultation information	MISA system, web-site of the department, information stands of the department

2. Short summary of the course

General characteristics, short summary, peculiarities and advantages of the course.

Elective course “Metabolism of drugs” according to the academic program is an optional discipline, prepared for students of the 3rd year in the 6th semester. The discipline includes 90 hours (3,0 credits), including 10 hours of lectures, 20 hours of practical classes and 60 hours of the self-educational work.

The discipline “Metabolism of drugs” is divided into 2 sections: Section 1 “General characteristics of biotransformation of drugs”, Section 2 “Molecular mechanisms of action of drugs. Influence of exogenous and endogenous factors on drug metabolism. Side effects of medicines”.

Subject of study by the discipline is diagnostics and correction of pathological conditions associated with metabolic disorders by pharmaceutical drugs. The course "Metabolism of drugs" is based on knowledge of students of pharmaceutical faculty on biochemistry, pharmacology, biology, biophysics, medicinal chemistry (bioinorganic, physical and colloid chemistry), morphological disciplines and integrates these disciplines. The study of the discipline provides a high level of medical and biological training, lays the foundations for students to study clinical biochemistry, pharmacotherapy, clinical pharmacology, medical chemistry, toxicological chemistry, provides for the integration of teaching with these disciplines; forms the ability to apply the acquired knowledge in the process of further education and in professional activities; lays the foundations of professionally oriented thinking, a healthy lifestyle and prevention of disorders of the body in the process of human's life. Mastering the discipline is important for the formation of students' holistic and systematic understanding of biochemical mechanisms that provide biotransformation of xenobiotics in the body, the role of components of the biotransformation system in the disposal of various exogenous substances and in maintaining the basic parameters of homeostasis

3. Purpose and goals of the course

The purpose of the course "Metabolism of drugs" is to acquaint students with the basic processes of biotransformation of drugs in the human body and to study the biochemical mechanisms of action of various drugs during the treatment of pathologies, their interaction and side effects.

The main tasks in teaching of the course "Metabolism of drugs" are to train a future specialist of pharmacy with a sufficient amount of theoretical knowledge to conduct the most rational drug therapy for a particular patient, to teach a specialist with a methodology for individual selection of effective and safe drugs based on their metabolism and mechanism of action, taking into account dietary factors, external factors and physiological condition.

General competencies (GC), the formation of which provides the study of the discipline "Metabolism of Drugs":

- GC-1. Ability to abstract thinking, analysis and synthesis.
- GC-2. Ability to learn and master modern knowledge/
- GC-3. Ability to apply knowledge in practical situations.
- GC-4. Knowledge and understanding of the subject area and understanding of professional activity.
- GC-5. Ability to adapt and act in a new situation
- GC-6. Ability to make informed decisions.
- GC-7. Ability to work in a team.
- GC-8. Interpersonal skills.
- GC-10. Ability to communicate in a foreign language
- GC-11. Skills of using information and communication technologies.
- GC-12. Certainty and persistence in terms of tasks and responsibilities.
- GC-13. Ability to act socially responsibly and consciously.
- GC-14. The desire to preserve the environment.
- GC-15. Ability to act on the basis of ethical considerations (motives).

Professional competencies (PC) for the the discipline "Metabolism of Drugs":

PC 4. Ability to ensure the rational use of prescription and over-the-counter drugs and other pharmaceutical products in accordance with the physicochemical, pharmacological characteristics, biochemical, pathophysiological features of a particular disease and pharmacotherapeutic regimens for its treatment.

PC-5. Ability to monitor the effectiveness and safety of the use of drugs by the population according to the data on their clinical and pharmaceutical characteristics, as well as taking into account subjective signs and objective clinical, laboratory and instrumental criteria for examination of the patient.

PC-6. Ability to identify drugs, xenobiotics, toxins and their metabolites in body fluids and tissues, to conduct chemical and toxicological studies to diagnose acute poisoning, drug and alcohol intoxication.

PC 20. Ability to develop methods for quality control of medicines, including active pharmaceutical ingredients, medicinal plant raw materials and excipients using physical, chemical, physicochemical, biological, microbiological, pharmacotechnological and pharmacoorganoleptic methods.

Program learning results:

PLR-2. Apply knowledge of general and professional disciplines in professional activities.

PLR-4. Demonstrate the ability to independently search, analyze and synthesize information from various sources and use these results to solve typical and complex specialized tasks of professional activity

PLR-7. Perform professional activities using creative methods and approaches.

PLR-9. Carry out professional activities using information technology, "Information Databases", navigation systems, Internet resources, software and other information and communication technologies.

PLR-10. Adhere to the norms of communication in professional interaction with colleagues, management, consumers, work effectively in a team.

PLR-12. Analyze the information obtained as a result of scientific research, summarize, systematize and use it in professional activities.

PLR-16. To determine the influence of factors influencing the processes of absorption, distribution, deposition, metabolism and excretion of the drug and due to the condition, features of the human body and physicochemical properties of drugs.

PLR-18. Select biological objects of analysis, determine xenobiotics and their metabolites in biological environments and evaluate the results based on their distribution in the body.

4. Prerequisites for the course

To successfully study and master the competencies of the discipline "Metabolism of drugs", the student must have the appropriate basic knowledge and skills, in particular:

To know:

- classification and detoxification processes of drugs, toxins, carcinogens and other foreign substances;
- mechanisms of pathogenic action of xenobiotics and synthesized exogenous substances in case of their entry into the body;
- functioning of enzymes of xenobiotic metabolism and mechanisms that regulate the activity of these enzyme systems;
- the relationship of the processes of the first and second phases of detoxification;
- biochemical mechanisms of action of different groups of drugs.

To be able to:

- select molecular biological tests to determine the mutagenicity and carcinogenicity of chemical compounds;
- give structural and functional characteristics of xenobiotic detoxification enzymes;
- evaluate the mechanisms of microsomal oxidation in cell physiology and pathology;
- compare the data observed in the process of normal cell life with the changes that are characteristic of the pathology;
- predict the biological effect of synthesized substances on the body;
- apply the acquired theoretical knowledge to solve tests and problems.

5. Program results of training

List of learning results

The learning result code	The content of the learning results	Reference to the code of the competence matrix
<i>Knowledge-1 (Kn-1)</i>	To know the reactivity of the main classes of biomolecules, which provides their functional properties and metabolic transformations in the body.	<i>PLR-3</i>

<i>Kn-2</i>	To know the biochemical mechanisms of pathological processes in the human body.	<i>PLR-4</i>
<i>Kn-3</i>	To know the connection between the peculiarities of the structure and transformations in the body of bioorganic compounds as the basis of their pharmacological action as drugs.	<i>PLR-9</i>
<i>Kn-4</i>	To know the basic mechanisms of biochemical action and the principles of targeted use of different classes of pharmacological agents.	<i>PLR-10</i>
<i>Kn-5</i>	To know the functioning of enzymatic processes occurring in membranes and organelles to integrate metabolism in individual cells.	<i>PLR-15</i>
<i>Skill - (Sk-1)</i>	Interpret the features of the structure and transformations in the body of bioorganic compounds as the basis of their pharmacological action as drugs.	
<i>Sk-2</i>	Interpret the biochemical mechanisms of drug biotransformation processes in the human body.	
<i>Sk-3</i>	Explain the main mechanisms of biochemical action and the principles of targeted use of different classes of pharmacological agents.	
<i>Sk-4</i>	Interpret the importance of biochemical processes of metabolism and its regulation in ensuring the functioning of organs, systems and the whole human body.	
<i>Autonomy and responsibility (AR-1)</i>	Be responsible for the timely acquisition of modern knowledge.	
<i>AR-2</i>	Be responsible for the timely acquisition of basic general and professional knowledge.	
<i>AR -3</i>	Be responsible for the timeliness of decisions in these situations.	
<i>AR-4</i>	Be responsible for the timely acquisition of knowledge and handling of information.	
<i>AR-5</i>	Be responsible for the quality of work.	
<i>GC-1</i>	Ability to abstract thinking, analysis and synthesis.	
<i>GC-2</i>	Knowledge and understanding of the subject area and understanding of professional activity.	
<i>GC-3</i>	Ability to apply knowledge in practice.	
<i>GC-6</i>	Skills in the use of information and communication technologies.	
<i>GC-7</i>	Ability to search, process and analyze information from various sources.	
<i>GC-9</i>	Ability to identify, pose and solve problems.	
<i>GC-10</i>	The ability to be critical and self-critical.	
<i>GC-11</i>	Ability to work in a team.	
<i>GC-13</i>	The ability to act socially responsibly and consciously.	
<i>PC-1</i>	Ability to ensure the rational use of prescription and over-the-counter drugs and other pharmaceutical products in accordance with the physicochemical, pharmacological characteristics, biochemical, pathophysiological features of a particular disease and pharmacotherapeutic regimens for its treatment.	
<i>PC -2</i>	Ability to monitor the effectiveness and safety of the use of drugs by the population according to the data on	

	their clinical and pharmaceutical characteristics, as well as taking into account subjective signs and objective clinical, laboratory and instrumental criteria for examination of the patient.	
<i>PC -3</i>	Ability to identify drugs, xenobiotics, toxins and their metabolites in body fluids and tissues, to conduct chemical and toxicological studies to diagnose acute poisoning, drug and alcohol intoxication.	
<i>PC-4</i>	Ability to ensure proper storage of medicines and other products of the pharmacy range in accordance with their physico-chemical properties and the rules of Good Storage Practice (GSP) in health care facilities.	

6. Course format and scope

Course format	Full-time course	
Kind of occupations	Number of hours	Number of groups
Lerctures	10	1
Practical	-	1
Seminars	20	1
Self-training worl	60	1

7. Topics and content of the course

Code of class type	Topic	Content of the topic	Learning result code	Tutor
Lecture (<i>L-1</i>)	Biochemistry and clinical biochemistry of the liver. Mechanisms of action of hepatoprotective drugs.	To acquaint students with the peculiarities of the processes of neutralization of foreign molecules in the liver. Explain the mechanisms of pathogenic action of xenobiotics and synthesized exogenous substances in case of their entry into the body. Describe the biochemical mechanisms of action of hepatoprotective drugs.	Kn-1 Kn-2 Kn-3 Kn-6 Sk-1 Sk-3 AR-1 AR-2 GC-3	I.S. Fomenko
<i>L-2</i>	Microsomal oxidation. Phases of biotransformation of Drugs and endogenous toxic compounds. Microsomal oxidation reactions. II phase of biotransformation of medicines. Conjugation reactions in the liver.	To acquaint students with the functioning of the microsomal oxidation system of xenobiotics. To explain the functioning of enzymes of xenobiotic metabolism and mechanisms that regulate the activity of these enzyme systems; the relationship of the processes of the first and second phases of detoxification.	Kn-1 Kn-2 Kn-3 Kn-4 Kn-7 Sk-32 Sk-3 AR-1 AR-2 GC-1 GC-6	I.S. Fomenko
<i>L-3</i>	Antibiotics - inhibitors of transcription and translation, their	To acquaint students with the classification of antibiotics according to the	Kn-2 Kn-3 Kn-4	I.S. Fomenko

	mechanism of action.	mechanism of their influence on different stages of matrix synthesis, to explain the features of their influence and application for the treatment of infectious and oncological diseases	Sk-3 Sk-5 AR-1 AR-2 GC-1 GC-6	
L-4	Biochemical mechanisms of action of nonsteroidal anti-inflammatory drugs.	To acquaint students with the mechanisms of action of nonsteroidal anti-inflammatory drugs that selectively or non-selectively inhibit cyclooxygenase. Describe the mechanisms of side effects of these drugs and get acquainted with the latest developments.	Kn-1 Kn-2 Kn-3 Kn-4 Sk-2 Sk-3 AR-1 AR-2 GC-1 GC-6	I.S. Fomenko
L-5	Molecular mechanisms of action of antitumor drugs.	Introduce students to the biochemical mechanisms of carcinogenesis. Describe modern anticancer drugs, explain the mechanisms of side effects of their action.	Kn-1 Kn-2 Kn-3 Kn-4 Sk-2 Sk-3 GC-1 GC-6	I.S. Fomenko
S-1	General characteristics of ADME (Absorption – Distribution – Metabolism – Excretion), phases I and II of biotransformation of drugs	General characteristics of ADME. Relationship between physicochemical and structural properties of molecules with their basic pharmacokinetic parameters, such as absorption, distribution, metabolism and excretion.	Kn-1 Kn-2 Kn-3 Kn-4 Sk-1 Sk-4 AR-1 AR-2 AR-4 GC-4 GC-6	I.S. Fomenko
S-2	General characteristics phases I and II of drugs biotransformation in liver.	Electron transport chains in the membranes of the endoplasmic reticulum of hepatocytes, the sequence of components. Biological role of cytochrome P-450.	Kn-1 Kn-2 Kn-3 Kn-4 Sk-1 Sk-4 AR-1 AR-2 AR-4 GC-4 GC-11 PC-1	I.S. Fomenko
S-3	Types of reactions of biotransformation of chemical compounds in the liver.	Types of reactions of biotransformation of chemical compounds in the liver. Microsomal oxidation	Kn-1 Kn-2 Kn-3 Kn-4	I.S. Fomenko

		reactions. Biochemical mechanisms of conjugation reactions in hepatocytes. Functional significance of reactions with glucuronic acid, with PAPS, with glutathione, glycine, methylation and acetylation reactions.	Sk-1 Sk-4 AR-1 AR-2 AR-4 GC-4 GC-6	
S-4	Inducers and inhibitors of microsomal oxidation.	Drugs acting as inducers and inhibitors of microsomal oxygenases, mechanisms of their influence on metabolism. Development of drug tolerance. Phenomena that occur with repeated and combined use of drugs. Addiction, accumulation, passion (drug addiction).	Kn-1 Kn-2 Kn-3 Kn-4 Sk-1 Sk-4 AR-1 AR-2 AR-4 GC-4 GC-9 PC-1 PC-3	I.S. Fomenko
S-5	Characteristics and physiological significance of the main proteolytic enzymes.	Drugs acting as inducers and inhibitors of microsomal oxygenases, mechanisms of their influence on metabolism. Development of drug tolerance. Phenomena that occur with repeated and combined use of drugs. Addiction, accumulation, passion (drug addiction).	Kn-1 Kn-2 Kn-3 Kn-4 Sk-1 Sk-4 AR-1 AR-2 AR-4 GC-4 GC-8 PC-1 PC-2	I.S. Fomenko
S-6	Molecular mechanisms of action of antibiotics.	Classification of antibiotics by chemical structure and mechanism of action. Types and spectrum of antimicrobial action of antibiotics, their application in clinical practice. Molecular mechanisms of action of antibiotics - inhibitors of transcription and translation. Mechanisms of antibiotic resistance development and ways to overcome it. Conditions for the rational use of antibiotics. The concept of dysbiosis, pre- and probiotics. Principles of effective and	Kn-1 Kn-2 Kn-7 AR-1 AR-2 AR-4 AR-5 AR-6 GC-1 GC-2 GC-3 PC-1 PC-2 PC-3 PC-4	I.S. Fomenko

		safe use of antibiotics, pre- and probiotics		
S-7	Molecular mechanisms of action of NSAIDs.	Classification and nomenclature of modern NSAIDs depending on the chemical structure, origin and degree of selectivity for cyclooxygenases. Modern ideas about the mechanism of action of nonsteroidal anti-inflammatory drugs (NSAIDs) from the standpoint of the cyclooxygenase concept. Comparative characteristics of traditional and modern NSAIDs. Prospects for the creation of NSAIDs with a non-traditional mechanism of action. Comparative characteristics of steroidal and nonsteroidal anti-inflammatory drugs.	Kn-1 Kn-8 Sk-1 AR-1 AR-2 AR-4 AR-5 AR-6 GC-1 GC-2 GC-3 GC-6 GC-7 GC-11 PC-1 PC-2 PC-3	I.S. Fomenko
S-8	Molecular mechanisms of action of antihypertensive drugs	Classification of antihypertensive drugs. Antihypertensive drugs that inhibit angiotensin-converting enzyme. α 1-Adrenoblockers, β -Adrenoblockers sympatholytics, vasodilators	Kn-2 Kn-3 Sk-1 AR-1 AR-2 AR-4 AR-5 AR-6 GC-1 GC-2 GC-3 GC-6 GC-7 GC-11 PC-2	I.S. Fomenko
S-9	Molecular mechanisms of action of antitumor drugs	Biochemical mechanisms of carcinogenesis. Influence of carcinogens of different nature. Modern anticancer drugs, mechanisms of their action, side effects.	Kn-1 Sk-1 AR-1 AR-2 AR-4 GC-1 GC-2 GC-3 GC-6 GC-7 GC-11 PC-2 PC-3	I.S. Fomenko
S-10	Mechanisms for the implementation of the pharmacological action of	The concept of receptors. Interaction of drugs with receptors. Involvement of	Kn-2 Kn-4 Kn-2	I.S. Fomenko

	drugs.	receptors and potential-dependent channels in the mechanisms of action of drugs. Classification and characterization of drugs that block receptors, their use in practical medicine. Biochemical mechanisms of their action. Influence of nutrition and environmental factors on drug metabolism. Classification of side effects of drugs.	Sk-5 AR-1 AR-2 AR-4 AR-5 GC-1 GC-2 GC-3 GC-11 PC-2	
SWS-1 (self-training work 1)	Atypical reactions to drugs with hereditary metabolic diseases. Hereditary defects of enzyme systems, which are manifested in the use of drugs.	Pharmacogenetics. Genome sequencing. Causes and consequences of atypical reactions to drugs.	AR-1 AR-2 AR-4 AR-5 GC-6 GC-7	I.S. Fomenko
SWS-2	The receptor theory of the action of drugs. The main properties of the receptors. Types of receptors. Classification of substances depending on the nature of interaction with receptors	Types of receptors. Classification of substances depending on the nature of interaction with receptors	AR-1 AR-2 AR-4 AR-5 GC-6 GC-7	I.S. Fomenko
SWS-3	Main principles of the use of drugs depending on the meal. Influence of the nature of nutrition on the pharmacokinetic and pharmacodynamic properties of drugs.	The influence of the nature of nutrition on the pharmacokinetic and pharmacodynamic properties of drugs.	AR-1 AR-2 AR-4 AR-5 GC-6 GC-7	I.S. Fomenko
SWS-4	Specificity of the use of drugs during pregnancy.	Medicines that do not penetrate the placenta and therefore do not cause direct harm to the fetus. Drugs that penetrate the placenta but do not harm the fetus. Drugs that penetrate the placenta and accumulate in the tissues of the fetus, there is a risk of damage to the fetus.	Kn-3 AR-1 AR-2 AR-4 AR-5	I.S. Fomenko
SWS-5	Dependence of drug metabolism on age characteristics.	Features of pharmacological action of drugs in elderly and senile patients due to morphological, metabolic and functional disorders occurring in the body during aging, as well as age-specific development and course of diseases,	Kn-2 Sk-1 AR-1 AR-2 AR-4 AR-5 GC-6 GC-7	I.S. Fomenko

		polymorbidity characteristic of this age.		
SWS-6	Drug dependence. Her kinds, manifestations. Physiological mechanisms of dependence. Medical and social aspects of drug dependence.	Addictive substances: alcohol-barbiturate type (ethyl alcohol, phenobarbital); type of cannabis (marijuana, hashish); type of phenamine (amphetamine group); type of cocaine; type of essential solvents (toluene, acetone, carbon tetrachloride); substances that cause hallucinations - hallucinogens (LSD, mescaline, psilocibin); substances derived from opium (morphine, codeine), and their synthetic substitutes (trimeperidine, pentazocine).	Kn-2 Kn-3 Sk-1 AR-1 AR-2 AR-4 AR-5 GC-6 GC-7	I.S. Fomenko
SWS-7	Physiological role and features of serotonin metabolism. Agonists and serotonin receptor antagonists. Their significance in clinical practice.	Serotonin receptor agonists and antagonists. Their importance in clinical practice	Kn-2 Kn-3 Sk-1 AR-1 AR-2 AR-4 AR-5 GC-6 GC-7	I.S. Fomenko
SWS-8	Interaction of medicinal products, types of side effects of drugs, complications of drug therapy.	Side effects of drugs: drug allergy, embryotoxic, teratogenic, fetotoxic, mutagenic, carcinogenic effects. Specific undesirable (organotropic) effect of drugs. Basic principles and types of interaction of therapeutic agents. Effects of drugs in combination: synergism, potentiation, antagonism.	Kn-2 Kn-3 Sk-1 AR-1 AR-2 AR-4 AR-5 GC-6 GC-7	I.S. Fomenko

The main forms of organization of training - problem and review lectures, seminars, self-study of extracurricular topics provided by the work program of the discipline. The main teaching methods are productive: problem-based presentation, part-search, business games, lectures with multimedia support, practical-calculation tasks. While teaching the discipline, problem-oriented, professionally-oriented, interdisciplinary approaches to learning are used.

8. Verification of learning results

Current control

is carried out during the training sessions and aims to check the assimilation of students' educational material (it is necessary to describe the forms of current control during the training sessions). Forms of assessment of current educational activities should be standardized and include control of theoretical and practical training. The final grade for the current educational activity is set on a 4-

point (national) scale			
Learning result code	Code type classes	Method of verifying learning results	Enrollment criteria
<p><i>Kn-1</i> <i>Kn-2</i> <i>Kn-3</i> <i>Kn-4</i> <i>Kn-5</i> <i>Kn-6</i> <i>Sk-1</i> <i>Sk-2</i> <i>Sk-3</i> <i>Sk-4</i> <i>AR-1</i> <i>AR-2</i> <i>GC-1</i> <i>GC-2</i> <i>GC-3</i></p>	<p><i>L-1, L-2,</i> <i>L-3, L-4,</i> <i>L-5</i></p>	<p>Types of educational activities of students are: a) lectures b) seminars c) self-training work (STW)</p> <p>Thematic plans of lectures, practical classes, STW ensure the implementation in the educational process of all topics included in the content of the program.</p> <p>The lecture course consists of 5 lectures. The topics of the lecture course reveal problematic issues. During lectures, students form theoretical knowledge, provide a motivational component and a general-indicative stage of mastering scientific knowledge during independent work. The lecture course makes maximum use of various didactic tools - multimedia presentations, educational films, slides.</p>	
<p><i>Kn-1</i> <i>Kn-2</i> <i>Kn-3</i> <i>Kn-4</i> <i>Kn-5</i> <i>Kn-6</i> <i>Sk-1</i> <i>Sk-2</i> <i>Sk-3</i> <i>Sk-4</i> <i>AR-1</i> <i>AR-2</i> <i>AR-3</i> <i>AR-4</i> <i>AR-5</i> <i>GC-1</i> <i>GC-2</i> <i>GC-3</i></p>	<p><i>S-1, S-2,</i> <i>S-3, S-4,</i> <i>S-5, S-6,</i> <i>S-7, S-8,</i> <i>S-9, S-10,</i></p>	<p>Seminars are aimed at controlling the assimilation of theoretical material, the formation of practical skills and abilities, as well as the ability to analyze and apply the acquired knowledge to solve practical problems.</p> <p>Each lesson begins with a test control (20 tests) to assess the initial level of knowledge and determine the degree of readiness of students for the lesson. The teacher determines the purpose of the lesson and creates a positive cognitive motivation; answers questions from students who arose during the SWS on the topic of the lesson.</p>	<p>The grade "excellent" is given to the student who took an active part in the discussion of the most difficult questions on the topic of the lesson, gave at least 19-20 correct answers to standardized test tasks, answered the written tasks without errors.</p> <p>A grade of "good" is given to a student who took part in the discussion of the most difficult questions on the topic, gave at least 17-18 correct answers to standardized test tasks, made some minor mistakes in answering written tasks.</p> <p>A grade of "satisfactory" is given to a student who did not participate in the discussion of the most difficult questions on the topic, gave at least</p>

GC-6 GC-7 GC-9 GC-10 GC-11 GC-13 PC-1 PC-2 PC-3	At the final stage of the lesson in order to assess the student's mastery of the topic he is asked to answer three theoretical questions. The teacher summarizes the lesson, gives students tasks for independent work, points out the main issues of the next topic and offers a list of recommended reading. The duration of the seminar is 2 academic hours.	14-16 correct answers to standardized test tasks, made significant mistakes in answering written tasks A grade of "unsatisfactory" is given to a student who did not participate in the discussion of the most difficult questions on the topic, gave less than 14 correct answers to standardized test tasks, made gross mistakes in answering written tasks or did not answer them at all.
-------------------------------------------------------------------------	-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Final control

During the study of the elective course "Drug Metabolism" the control of knowledge is conducted, which include the current and final semester control and certification of graduates. According to the curriculum, the form of final control is a test.

Current control is carried out during classes and aims to verify the assimilation of students' learning material. The form of current control during training is determined by the working curriculum of the discipline.

Evaluation of current educational activities. During the assessment of mastering each topic for the current educational activity of the student, grades are set on a 4-point (traditional) scale, taking into account the approved assessment criteria for the relevant discipline. This takes into account all types of work provided by the curriculum. The student must receive a grade for each topic. Forms of assessment of current educational activities should be standardized and include control of theoretical and practical training. Scores on the traditional scale are converted into points.

Для дисциплін формою підсумкового контролю яких є залік (диференційований залік):

For disciplines whose form of final control is credit (differentiated credit):

The maximum number of points that a student can score for the current educational activity in the study of the discipline is 200 points.

The minimum number of points that a student must score for the current academic activity to enroll in the discipline is 120 points.

The calculation of the number of points is based on the grades obtained by the student on a traditional scale during the study of the discipline during the semester, by calculating the arithmetic mean (AM), rounded to two decimal places. The resulting value is converted into points on a multi-point scale as follows:

$$x = AM \times 200 / 5$$

For convenience, the table of recalculation on a 200-point scale is given:

Calculation of the average score for current activities in a multi-point scale for disciplines ending with a credit (differentiated credit).

4-score scale	200-score scale	4.95	119	4.79	115	4.62	111
		4.91	118	4.75	114	4.58	110
5	120	4.87	117	4.7	113	4.54	109
		4.83	116	4.66	112	4.5	108
4.45	107	3.95	95	3.58	86	3.2	77
4.29	103	3.91	94	3.41	82	3.04	73
4.12	99	3.74	90	3.37	81	3.0	72

The final control is conducted to evaluate the results of the training at a certain educational-qualifying level and at individual completed stages according to the national scale and the ECTS scale. Final control includes semester control and student attestation.

Semester control is conducted in the form of a semester exam or a set (differentiated score) from a

specific academic discipline in the amount of study material determined by the work program of the discipline and in the terms set by the work curriculum, the individual student's curriculum.

Determination of the number of points the student got from the discipline

An assessment from the disciplines, the final form of which is the score (differential grade), is based on the results of the current academic activity and is expressed on a two-point scale "enrolled" or "not enrolled". To enroll the student must receive for the current educational activity a ball not less than 60% of the maximum amount of points in discipline (120 points).

Discipline points are independently converted into both the ECTS and 4-point scale. The ECTS scores on the 4-point scale are not converted and vice versa. Points of students studying in one specialty, taking into account the number of points scored from the discipline, are ranked on the ECTS scale as follows:

Score ECTS	Statistical index
A	Best 10 % students
B	Next 25 % students
C	Next 30 % students
D	Next 25 % students
E	Last 10 % students

Score points for students who have successfully completed the program are converted to the traditional 4-point scale by the absolute criteria listed in the table below:

Points from a course	Score 4-point scale
From 170 to 200 points	5
From 140 to 169 points	4
From 139 points to the minimum the number of points that should be obtained by a student	3
Below is the minimum number of points that the student should collect	2

The ECTS mark on a traditional scale is not converted because the ECTS scale and the four-point scale are independent.

Objectivity of assessment of students' educational activity is checked by statistical methods (correlation coefficient between ECTS assessment and national scale assessment).

9. Course policy

The policy of the course "Biochemistry of drugs" is determined by a system of requirements for the student in the study of the discipline and is based on the principles of academic integrity. Students are explained the value of acquiring new knowledge, the need for independent performance of all types of work, tasks provided by the work program of this discipline. Lack of references to used sources, fabrication of sources, writing off, interference in the work of other students are examples of possible academic dishonesty. Detection of signs of academic dishonesty in the student's work is the basis for its non-enrollment by the teacher, regardless of the extent of plagiarism or deception. Literary sources may be provided by the teacher exclusively for educational purposes without the right to transfer to third parties. Students are encouraged to use other literature sources not provided by the recommended list.

10. References

1. Doble M., Kruthiventi A.K. Biotransformations and Bioprocesses. CRC Press, 2004. 406p.
2. Nassar A.F. Biotransformation and Metabolite Elucidation of Xenobiotics: Characterization and Identification. 1st Edition, Wiley. 418 p.
3. Kaplan S. A Comprehensive Guide to Non-Steroidal Anti-Inflammatory Drugs. 529 p.
4. Harper's Illustrated Biochemistry 30th edition. V. W. Rodwell et al.; NY: McGraw-Hill Education, 2015. 817 p.
5. Satyanarayana U., Chakrapani U. Biochemistry. Fifth edition, N.Delhy: Elsevier, co-published with Book and Allied, 2017. 788 p.
6. Nelson D.L., Cox M.M. Lehninger Principles of Biochemistry. Fifth edition. NY: W.H. Freeman and Company, 2005. 1010 p.

7. Swanson T. A., Kim S. I., Glucksman M. J. Biochemistry, Molecular Biology, and Genetics 5th edition / Lippincott Williams & Wilkins, 2010. 380 p.
8. Devlin T. M. ed. Textbook of Biochemistry with Clinical Correlations, 7th edition. Hoboken: Wiley-Liss, 2010. 1240 p.
9. Trudy McKee, James R. McKee. Biochemistry. The molecular basis of life. Sixth edition. Oxford University Press, 2015. 928 p.
10. MCQs in biochemistry 2nd edition / A. Ya. Sklyarov et al.: Lviv: Danylo Halytsky Lviv National Medical University Press, 2020. 319 p.

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

working curriculum of the discipline; multimedia support of lectures, methodical recommendations and developments for the teacher; methodical instructions for practical classes for students; methodical materials that provide independent work of students; test and control tasks for practical classes, educational content (synopsis or extended plan of lectures), plans of practical classes, questions, tasks.

Information resource - <http://misa.meduniv.lviv.ua/>

Testing Center - a database of licensed test tasks Step– 1 <http://testcentr.org.ua/>

Compiler of the syllabus
Professor I.S. Fomenko,
Doctor of Biological Sciences

Head of the department
Professor O.Ya. Sklyarov,
MD, Doctor of Medical Science
