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Edition:

06

Date:

20.09.2017

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FACULTY OF PHARMACY STUDY PROGRAM 0916.1 PHARMACY CHAIR OF BIOCHEMISTRY AND CLINICAL BIOCHEMISTRY

APPROVED

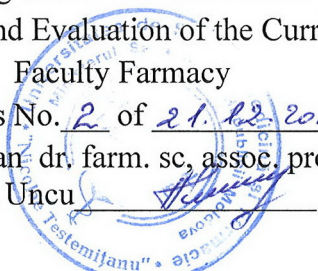
at the meeting of the Commission for Quality Assurance and Evaluation of the Curriculum

Faculty Pharmacy

Minutes No. 2 of 21.12.2017

Chairman dr. farm. sc, assoc. prof.

Livia Uncu



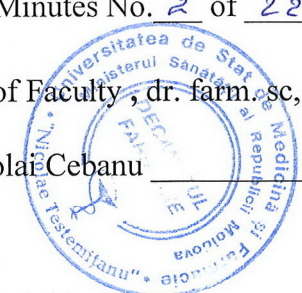
APPROVED

at the Council meeting of the Faculty Pharmacy

Minutes No. 2 of 22.12.2017

Dean of Faculty, dr. farm. sc, assoc. prof

Nicolai Cebanu



APPROVED

approved at the meeting of the chair biochemistry and clinical biochemistry

Minutes No. 7 of 1.XI.2017

Head of the chair dr. Hab. Med., assoc. Prof.

Tagadiuc Olga

SYLLABUS PHARMACEUTICAL BIOCHEMISTRY

Integrated studies

Type of course: **Compulsory**

Chisinau, 2017



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I. INTRODUCTION

General presentation of the discipline: place and role of the discipline in the formation of the specific competences of the vocational / specialty training program

Biochemistry aims to provide students with fundamental theoretical knowledge and general practical skills in biochemistry that are indispensable to the professional work of all health professionals, including pharmacists. Students will study biochemical bases for the existence and functioning of the human body in physiological conditions, disorders in some diseases and some biochemical mechanisms in the treatment of these diseases. The activities of the discipline study will create the students' individual and team work skills, formulation and problem solving, working on certain laboratory equipments, analyzing and interpreting the results of medical investigations, application of theoretical knowledge in pharmacy practice, integration of information from different disciplines (fundamental and clinical), etc.

The mission of the curriculum in vocational training is to study a) fundamental metabolic processes that underlie the functionality of living organisms; b) the particularities of the metabolic processes that ensure the functioning of the human organism, the mechanisms underlying the genesis of diseases and the treatment of these diseases; c) biochemical investigation methods of clinical utility and the development of laboratory analysis and interpretation skills, including those in the practice of future pharmacists.

Teaching language of the subject: Romanian and English

Beneficiaries: Students of the Pharmacy Programm (integrated studies)

II. MANAGEMENT OF THE DISCIPLINE

Code of discipline		S.05.O.051/S.06.O.060	
Name of the discipline		Pharmaceutical Biochemistry	
Person(s) in charge of the discipline		Svetlana Bobcova	
Year	III	Semester/Semesters	V/VI
Total number of hours, including:			
Lectures	17+17	Practical/laboratory hours	17+17
Seminars	34+34	Self-training	104 (22+82)
Form of assessment	C/E	Number of credits	8 (3+5)

III. TRAINING AIMS WITHIN THE DISCIPLINE

At the end of the discipline study the student will be able to:

a) at the level of knowledge and understanding:

- to know the fundamental metabolic processes that ensure the viability and reproduction of the human body;
- to know the metabolic features of organs (tissues);



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- to know the influence of various factors (vitamins, pharmaceuticals, toxins, metals) on metabolic processes;
 - to assimilate the normal values and physiological variations of the main biochemical indices.
- b) at application level:
- to determine by itself some biochemical parameters of general clinical-diagnostic utility
 - to possess the way of working with the main equipments used in the biochemical laboratory (simple and automatic pipettes, photoelectric colorimeter, centrifuge, etc.);
 - to appreciate the usefulness of certain biochemical investigations in the diagnosis of some specific disease;
 - to interpret correctly the results of biochemical investigations
 - to understand the principles of the mechanisms of action of medicinal preparations
 - to know the mechanisms of detoxification of drugs and toxins
- c) at the level of integration:
- to appreciate the importance of Biochemistry in the context of Pharmaceutical courses and the application of the knowledge gained in the field of the future profession of pharmacist
 - to know the correlations between Biochemistry and other fundamental, pharmaceutical and hygiene disciplines
 - objectifying the connections and interdependence between structural, metabolic and farmaceutical biochemistry
 - to appreciate the evolution of physiological metabolic processes and their disorders that condition various diseases, as well as some mechanisms of treatment of these diseases

IV. PROVISIONAL TERMS AND CONDITIONS

Biochemistry is a medical-biological discipline, the study of which at the Bachelor's degree stage will allow future pharmacists to know the molecular basis of physiological metabolic processes, the biochemical mechanisms to regulate the function of different organs, to understand the causes and pathogenesis of hereditary and acquired diseases wich determines their impact, to argues the need for biochemical investigation, to interprets the results of the laboratory test and to correlates them with clinical and functional data in order to establish diagnosis, life style correction and indication of therapies adapted to the biochemical mechanisms that cause the disease.

To learn the discipline requires thorough knowledge in the field of General Chemistry, Organic Chemistry, Inorganic Chemistry, and Biology, obtained in the pre-university studies, as well as in the field of Human Anatomy, Histology and Physiology, Physical and Analytical Chemistry, Colloidal Chemistry obtained in the undergraduate studies.

Internet skills are also required to identify the materials needed for study and individual work, document processing, spreadsheets and presentations.



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V. THE MES AND ESTIMATE ALLOCATION OF HOURS

Lectures, practical hours/ laboratory hours/seminars and self-training

No. d/o	THEME	Number of hours		
		Lectures	Practical hours	Self-training
1.	Subject of biochemistry. The role of biochemistry for pharmacists. Natural biologically active and bacterial peptides (antibiotics). Proteins. The primary, secondary, tertiary, quaternary structure of proteins and the methods of determination of these structures. Domain notion.	2	6	2
2.	Classification of proteins. Physico-chemical properties of proteins. Methods of separation and purification of proteins.	1	3	2
3.	Enzymes: chemical nature and structure. The general properties of enzymes. The active and allosteric center. Mechanism of action. Units of activity of enzymes. Vitamins. Enzyme cofactors. Chemical structure and biological role of vitamins B1, B2, B6, PP, biotin and folic acid. Pharmaceutical implications. The general properties of enzymes. Activation and inhibition of enzymatic reactions.	3	6	4
4.	Colloquy: Proteins and Enzymes		3	2
5.	Nucleotide biochemistry. Structure of DNA and RNA. Use of nucleotides in therapy. Replication. Telomerase and its role in the aging process. Transcription mechanism. Molecular Mutations. DNA repair. Translation mechanism, regulation. Structure and mechanism of action of antibiotics. Genetic engineering.	2	9	4
6.	Colloquy: Metabolism of Nucleic Acids		3	2
7.	General concepts about metabolism. Bioenergetics. Energy status of the cell. The phases of catabolism. Oxidative decarboxylation of pyruvate. The Krebs cycle. Partial reactions of the tricarboxylic acid cycle. Anaplerotic reactions.	2	3	2
8.	Biological oxidation. Respiratory chain. Oxidatio- Reduction Potential. Structure of proton and electron carriers. Mitchell's hypothesis. Microsomal oxidation.	2	3	2
9.	The biological role of carbohydrates. Digestion of carbohydrates. Biosynthesis and degradation of glycogen.	1	3	2
10.	Aerobic and anaerobic glycolysis. Shuttle systems (malate-aspartate and glycerol-phosphate). Energy balance. Gluconeogenesis.	1	3	2



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No. d/o	THEME	Number of hours		
		Lectures	Practical hours	Self-training
11.	Alcoholic fermentation of glucose. Pentosephosphate pathway for glucose oxidation. Metabolism of fructose and galactose. Regulation and pathology of glucose metabolism.	1	1.5	1
12.	Subject of biochemistry. The role of biochemistry for pharmacists. Natural biologically active and bacterial peptides (antibiotics). Proteins. The primary, secondary, tertiary, quaternary structure of proteins and the methods of determination of these structures. Domain notion.	2	6	2
13.	Colloquy: Bioenergetics and Carbohydrates metabolism		6	4
14.	Lipid classification and structure. Biological membranes. Digestion and absorption of lipids in the digestive tract. Plasma lipoproteins. Lipid mobilization, β -oxidation of fatty acids.	2	6	8
15.	Biosynthesis of fatty acids. Biosynthesis of triglycerides and phospholipids. Cholesterol biosynthesis. Metabolism of ketone bodies. Liposoluble vitamins. Prostaglandins and their role in the body and treatment of various diseases.	2	3	4
16.	Colloquy: Metabolism of Lipids		3	2
17.	Biological value of proteins. Digestion of proteins and absorption of amino acids in the intestine. Detoxification of the putrefaction products in the liver. Decarboxylation of amino acids. Biogenic amines and their detoxification. Direct and indirect deamination of amino acids. Transamination. Biosynthesis of urea.	2	6	4
18.	Particularities of the metabolism of some amino acids. The role of tetrahydrofolic acid. Mechanism of action of sulfanilamides. Metabolism of phenylalanine, serine, cysteine, glycine. Mutual interaction between glucose, lipid and protein metabolism.	1	3	4
19.	Metabolism of nucleo- and chromoproteins	1	3	8
20.	Colloquy: Metabolism of simple and conjugate Proteins		3	2
21.	Structure and classification of hormones. Mechanisms of action of hormones. Hormones of hypothalamus and pituitary. Hormones of parathyroid gland. The use of these hormones in therapy.	2	3	8
22.	Hormones of the thyroid, pancreas and adrenal gland. Sex hormones (estrogens and androgens) and the use of sex hormones as anabolic agents.	2	3	8



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No. d/o	THEME	Number of hours		
		Lectures	Practical hours	Self-training
23.	Biochemistry of blood. The chemical composition of the plasma. Hydromineral metabolism. Inorganic substances (ionogram). Respiratory function of blood. Biochemical features of erythrocytes.	1	3	4
24.	Buffer systems. Acidosis and alkalosis. Blood coagulation and fibrinolytic system. Biochemical features of platelets and leukocytes.	1	3	4
25.	Pharmaceutical biochemistry. Contemporary drug forms. Biotechnology of medicinal preparations. Obtaining, dosing and standardizing of drugs. Metabolism of drugs and xenobiotics in the body.	2	3	8
26.	Microsomal oxidation of substances, reductase and oxygenase chains. Xenobiotic conjugate mechanisms.	2	3	6
27.	Colloquy: Hormones, Blood and Metabolism of Drugs		6	4
Total		34	102	104

V. REFERENCE OBJECTIVES OF CONTENT UNITS

Objectives	Content units
Chapter 1. Structure and properties of proteins	
<ol style="list-style-type: none"> 1. To define the role of biochemistry for pharmacists 2. To know the levels of structure and the methods of determination of these structures 3. To know the classification and physico-chemical properties of proteins 4. To apply methods for separating and purifying of proteins 	<ol style="list-style-type: none"> 1. The role of biochemistry for the future pharmacist. 2. Primary, secondary, tertiary, quaternary protein structure. 3. Methods of determination of these structures. 4. Physico-chemical properties of proteins. 5. Methods of separation and purification of proteins. 6. Using of peptides and proteins as medicaments.



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Objectives

Content units

Chapter 2. Structure and properties of enzymes

1. To define the notion of enzyme and coenzyme.
2. To define the cofactors of the enzymes and know their chemical structure.
3. To identify the specific enzymes of some organs.
4. To know the mechanism of enzymes action.
5. To apply the enzyme activity evaluation methods.
6. To explain the clinical-diagnostic value of enzymes in general and their application in pharmacy.

1. The notion of enzyme.
2. Structure of enzymes and their main properties.
3. Properties of enzymes resulting from their protein nature.
4. Cofactors of enzymes, chemical structure and biological role of vitamins B1, B2, B6, PP, C, biotin, folic acid.
5. Specific enzymes of different organs and their clinical-diagnostic value.
6. Mechanism of action of enzymes.
7. Activation and inhibition mechanisms of enzymes activity.
8. Methods of enzyme activity evaluation.
9. Clinical-diagnostic value of enzymes in general and their application as medication.
10. Pharmaceutical enzymes.

Chapter 3. Metabolism of Nucleic Acids

1. To define the notion of nucleic acids
2. To know the structures of DNA and RNA
3. To demonstrate biochemical mechanisms and identify the similarities and differences of replication, transcription and translation processes
4. To apply obtained knowledge to identify the mechanisms of hereditary disease

1. The notions of nitrogenous base, nucleoside and nucleotide
2. Structure of Nucleic Acids (DNA and RNA)
3. Localization and molecular bases of replication
4. Localization and mechanism of prokaryote transcription
5. Post-transcriptional effects
6. The notion of ribosomes and their role in translation
7. The genetic code and its properties
8. The translation mechanism
9. Post-translational effects
10. Particularities of replication, transcription and translation to eucariots

Chapter 4. Bioenergetics

1. To define the notions of metabolism, anabolism, catabolism.

1. Notion of metabolism.
2. Anabolism and catabolism. The amphibolic pathway of metabolism.
3. The phases of catabolism.



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Objectives

2. To apply the laws and main principles of thermodynamics to living organisms.
3. To know the biological importance of the main energy processes in the human body.
4. To know the main bioenergetic processes in human cells.
5. To demonstrate the connections between the main important energy processes in the cell.

Content units

4. The main laws of thermodynamics.
5. Bioenergetics. Macroergic compounds. The ATP cycle. Energy state of the cell.
6. Oxidative decarboxylation of pyruvate.
7. The partial reactions and energy balance of the Krebs Cycle
8. Location and structure of the respiratory chain. Complexes I, II, III, IV.
9. Oxidative phosphorylation. Mechanism of coupling of oxidation with oxidative phosphorylation (P. Mitchell chemiosmotic theory).

Chapter 5. Metabolism of carbohydrates

1. To identify the stages of digestion of carbohydrates and glucose utilization.
2. To know how to metabolize sugars under different physiological and pathological conditions.
3. To understand the connections between the carbohydrate and energy metabolism processes.
4. To be able to calculate the energy efficiency of anaerobic and aerobic oxidation of individual carbohydrates.
5. To apply biochemical investigations to assess glucose metabolism disorders.

1. The biomedical role of carbohydrates.
2. Stages of digestion and absorption of sugars and enzymes involved in this process.
3. Synthesis and mobilization of glycogen. Hormonal regulation of this process.
4. Partial anaerobic, aerobic glycolysis reactions.
5. Adjustment and energy efficiency of anaerobic and aerobic glycolysis.
6. Gluconeogenesis
7. Metabolism of fructose and galactose. Pathologies associated with this metabolism.
8. Pentose phosphate pathway: role and partial reactions of the oxidative pathway.
9. Adjustment and disturbances of carbohydrate metabolism General concepts about metabolism assessment methods.
10. Biochemical mechanism of photosynthesis. Phase to light and phase to darkness.
11. Reactions of the Calvin cycle.

Chapter 6. Lipid metabolism

1. To define lipids and appreciate their biomedical role.
2. To identify the stages of lipid digestion, absorption,

1. The biomedical role of lipids.
2. Lipid digestion, absorption and transport. General concepts for plasma lipoproteins.
3. Structure and functions of fatty acids.



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Objectives	Content units
<p>resynthesis, transport and associated disorders.</p> <p>3. To know the ways of lipid metabolism in different tissues and the regulatory mechanisms involved.</p> <p>4. To understand the connections between the processes of lipid, carbohydrate and energy metabolism.</p> <p>5. To know the role of prostaglandins found in different pathogens and used as drugs.</p> <p>6. To know the structure of biological membranes and liposoluble vitamine.</p>	<p>4. Synthesis of saturated fatty acids, multenzymatical complex palmitate synthase.</p> <p>5. Elongation of fatty acids. Synthesis of unsaturated fatty acids.</p> <p>6. Oxidation of fatty acids with even and odd carbon atoms.</p> <p>7. Energy yield of fatty acid oxidation.</p> <p>8. Metabolism of triglycerides.</p> <p>9. Metabolism of ketone bodies. Concepts of ketonectomy and ketonuria.</p> <p>10. Cholesterol metabolism.</p> <p>11. Metabolism of phospholipids and glycolipids.</p> <p>12. Regulation of lipid metabolism.</p> <p>13. Liposoluble vitamins.</p> <p>14. The main pathologies associated with lipid metabolism disorders.</p> <p>15. Synthesis of eicosanoids and their role in human oranism.</p>
<p>Chapter 7. Metabolism of Simple and Conjugated Proteins</p>	
<p>1. To identify the stages of digestion and absorption of proteins in the digestive tract.</p> <p>2. To define the types of nitrogen balance.</p> <p>3. Describe the main ammonia-generating processes and its toxicity mechanisms for the human body.</p> <p>4. To know how to temporarily and definitively detoxify ammonia.</p> <p>5. To be able to distinguish the main types of jaundice.</p> <p>6. To know pathways of nucleoproteins metabolism.</p> <p>7. To know the cause of gout disease and its treatment.</p>	<p>1. Digestion and absorption of proteins in digestive tract Dynamic state of proteins. The nitrogenous balance.</p> <p>2. General methods of amino acid metabolism: transamination and deamination.</p> <p>3. The final products of nitrogen metabolism.</p> <p>4. Ammonia toxicity mechanism.</p> <p>5. Temporary and final pathways of ammonia detoxification.</p> <p>6. Ureogenesis cycle. Ammonia and uremia.</p> <p>7. Decarboxylation of amino acids in tissues. Biogenic amines (histamine, serotonin): biological role and notions of inactivation.</p> <p>8. Metabolism of chromoproteins. Symptom and catabolism of hemoglobin. General terms about jaundice.</p> <p>9. Metabolism of nucleoproteins. Synthesis and degradation of purine and pyrimidine nucleotides.</p> <p>10. The cause of gout and its treatment.</p>



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Objectives

Content units

Chapter 8. Hormones.

1. To know the structure and classification of hormones.
2. To demonstrate the mechanisms of action of hormones.
3. To understand the functions of hypothalamus, pituitary and peripheral gland hormones.
4. To know the use of these hormones in therapy.

1. Structure and classification of hormones.
2. Mechanisms of action of hormones.
3. Functions of hypothalamus, pituitary.
4. Peripheral gland hormones, hormones of parathyroid gland.
5. Thyroid, pancreas, adrenal and sexual hormones.
6. Using of some hormones as drugs.

Chapter 9. Blood

1. To know the chemical composition of the blood and plasma.
2. To know hydro-saline metabolism and inorganic substances (ionogram).
3. To demonstrate the respiratory function of the bloodstream through the Hendersson Cycle.
4. To show the function of the buffer systems.
5. To know the pH limits in acidosis and alkalosis and to define the causes of these pathologies.
6. To know the blood clotting and fibrinolytic system.

1. Chemical composition of blood cells and blood plasma.
2. Hydro-saline metabolism and inorganic substances of blood.
3. Plasma composition: proteins, enzymes, nitrogenous non-proteins substances, organic non-nitrogenous substances.
4. The transport of oxygen from the lungs to the tissues, the cooperative mechanism. Hendersson cycle.
5. Carbon dioxide transport from tissues to lungs.
6. Buffer systems. Acidosis and alkalosis.
7. Coagulation of the blood and fibrinolytic system.
8. Anticoagulants used in the form of medications.
9. Medicines with fibrinolytic action.

Chapter 10. Metabolism of drugs

1. To know the biotechnology of medicinal products and the current forms of these medicines.
2. To acquire metabolism of drugs and xenobiotics in the body.

1. Biotechnology of medicinal preparations and contemporary forms of drugs.
2. Location of metabolism of drug substances in the body
3. Classification of drugs in terms of the activity of their metabolites.



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Objectives	Content units
<p>3. To familiarize yourself with microsomal oxidation used to detoxify xenobiotics.</p> <p>4. To apply the mechanisms of conjugation of xenobiotics to different drugs.</p>	<p>4. Fetal metabolites of xenobiotics: phase of modification and conjugation.</p> <p>5. Microsomal oxidation of substances (reductase and monooxygenase chains).</p> <p>6. Xenobiotic conjugation mechanisms (type I and II). Type I: glucuronide, sulphate, acetylic, methyl, theosulfate. Type II: conjugation with amino acids or glutathione.</p>

VI. PROFESSIONAL (SPECIFIC (SC)) AND TRANSVERSAL (TC) COMPETENCES AND STUDY OUTCOMES

Professional (specific) (SC) competences

CP1. Knowledge, understanding and use of language specific to medical biochemistry.

CP2. General knowledge of key vital chemical compounds for the human body.

CP3. Explaining the outcome of the main metabolic processes that ensure the viability of the body and the mechanisms of the most important disorders specific to nutritional disorders.

CP4. Advanced knowledge of the particulars of chemical composition and metabolism of the digestive system in physiological conditions and the most important digestive diseases related to cleavage and absorption.

CP5. Knowledge of the principles of biochemical laboratory methods, the diagnostic value of the main laboratory indices and the ability to interpret the results of basic laboratory investigations.

CP6. Possession of the working technique at the main laboratory equipment (spectrophotometer, centrifuge, automatic pipette, pH meter).

Transversal competences (TC)

TC1. Communication skills, written and oral, in the field of medicine and biochemistry.

TC2. Individual and team work skills.

TC3. Effective application of information technology in medical activity, as well as identification of sources of information and continuous education in the field of activity.

TC4. Understanding and the ability to apply the principles and values of general and professional ethics in action.

Study outcomes

Upon completion of the course the student will be able to:

1. To know the basic metabolic processes that ensure the viability and reproduction of the human organism,
2. To understand in depth the principles of the therapeutic approach of the main metabolic disorders that condition the various diseases and the biochemical mechanism of action of some drugs;



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No.	Expected product	Implementation strategies	Assessment criteria	Implementation terms
1.	Working with information sources	Selection of basic information and detailing questions to the lecture by reading the lecture, the material in the handbook and additional information sources on the topic. Full reading of text and systematization of essential content. Generalizations and conclusions about the importance of the theme / subject.	Level of assimilation of information and volume of work	During the year
2.	Working with online materials	Studying the teaching materials on the Department's website and completing the information on the studied subject.	Level of assimilation of information and volume of work	During the year
3.	Items for individual work solved	Self-solving of items for individual work on the subject in accordance with the Practical Guide, with subsequent verification by the teacher in non-auditory classes.	Note from 0-0.5 for each chapter: - The ability to solve the items for individual work and tests on that chapter.	Every theme studied
4.	Self-testing tests solved	Self-solving self-evaluation tests on the subject in accordance with the Practical Guide, with subsequent verification by the teacher in non-auditory classes.		Every theme studied
5.	Scientific report on contemporary themes presented to	Selection of basic information and details of the questions from the scientific sources of the last 5 years	Note from 0-1.0 for each report	During the semester



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the scientific circle at the chair and at scientific conferences.

3. To know and explain in detail the mechanisms of metabolism / detoxification of xenobiotics and drugs;
4. To know the normal values and the physiological changes of the main biochemical markers;
5. To appreciate the usefulness of certain biochemical investigations in the diagnosis of specific conditions and correctly interpret the results of biochemical investigations.
6. To determine independently some biochemical parameters of general clinical-diagnostic utility;
7. To solve individual case studies in pharmaceutical biochemistry.
8. To understand the mechanisms of developing pathologies and treating these diseases with corresponding drugs.

VII. STUDENT'S SELF-TRAINING

VIII. METHODOLOGICAL SUGGESTIONS FOR TEACHING-LEARNING-ASSESSMENT

Teaching and learning methods used

Biochemistry is taught according to the classical university standard: courses, laboratory workshops and seminars.

The course is held by the course holders.

Laboratory work is carried out in order to acquire easily accessible principles and methods for qualitative and quantitative biochemical analysis; the work is completed by completing the verbal processes and analyzing the results obtained.

The seminars discuss the theoretical subjects according to the methodical directions, solve the tests and problems of the situation, apply interactive methods of teaching and learning.

Students are encouraged to learn a variety of learning methods such as observation, analysis, comparison, classification / shape / shape analysis, modeling, deduction, and experiment.

Applied teaching strategies / technologies (specific to the discipline)

Teaching classical didactic strategies (inductive, deductive, analogous, algorithmic and heuristic) are applied in the teaching of the Biochemistry discipline, which are achieved with the help of several teaching-learning methods (active-participative, individual study, verification and evaluation) be exposure and didactic conversation, work with manual, theoretical problem and laboratory work, case study, test solving, etc. For the implementation of the strategies and methods, a set of technical means of training are used both in the courses and seminars, as well as in the laboratory works.



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Methods of assessment

Formative evaluation

Various current assessment methods are used for each laboratory work and seminars: control papers, problem solving and testing, problem solving, etc.

The Pharmaceutical Biochemistry discipline during the two semesters is 6 totals:

Totalization I: Proteins and Enzymes

Totalization II: Metabolism of Nucleic Acids

Totalisation III: Bioenergy and carbohydrate metabolism

Totalization IV: Lipid Metabolism

Totalization V: Protein Metabolism

Totalization VI: Hormone biochemistry, blood biochemistry and metabolism of drugs

Totalizations are supported by computer assisted testing (MOODLE) and oral response.

Summative assessment

The final grade for each semester will consist of the average mark from three totals (part 0.5) and the final test sample in computerized system (share 0.5).

The average annual mark and the marks of all stages of final examination (computer assisted, test, oral) - are expressed in numbers according to the mark scale (according to the table), and the final mark obtained is expressed in number with two decimals, which is transferred to student's record-book.

Method of mark rounding at different assessment stages

Intermediate marks scale (annual average, marks from the examination stages)	National Assessment System	ECTS Equivalent
1,00-3,00	2	F
3,01-4,99	4	FX
5,00	5	E
5,01-5,50	5,5	
5,51-6,0	6	
6,01-6,50	6,5	D
6,51-7,00	7	
7,01-7,50	7,5	C
7,51-8,00	8	
8,01-8,50	8,5	B
8,51-8,00	9	
9,01-9,50	9,5	A
9,51-10,0	10	

*Absence on examination without good reason is recorded as "absent" and is equivalent to 0 (zero).
The student has the right to have two re-examinations.*



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IX. RECOMMENDED LITERATURE:

A. Compulsory:

1. Lîsîi L. Biochimie medicală (ediția a doua). Chișinău, 2007.
2. Champe P.C., Harvey R.A., Ferrier D.R. Biochimie ilustrată. Ed. 4-a. București. Editura medicală Calisto, 2010.
3. Dinu V., Truția E., Popa-Cristea E., Popescu A. Biochimie medicală. Mic tratat. București, 1996.
4. Lîsîi L. Biochimie. Teste. Test-minim. Chișinău, 2008.
5. Lîsîi L. și alții. Biochimie. Lucrări practice. Chișinău, 2002.
6. www.biochimie.usmf.md. (Indicații metodice, suport teoretic).

B. Additional:

- 1 Nelson D.L., Cox M.M. Lehninger A. Principles of Biochemistry. Sixth Edition. 2012.
- 2 Bhagavan N.V., Ha Chung-Eun. Essentials of Medical Biochemistry: With Clinical Cases. Academic Press; 1st edition, 2011.
- 3 Champe Pamela C., Harvey Richard A. Biochemistry. Lippincott's Illustrated Reviews.
- 4 Gavriliuc L. Biochemistry. Lectures for student of Medical Departments. 2009.