FACULTY OF MEDICINE
STUDY PROGRAM 0912.1 MEDICINE
CHAIR OF BIOCHEMISTRY AND CLINICAL BIOCHEMISTRY

APPROVED
at the meeting of the Commission for Quality Assurance and Evaluation of the Curriculum faculty Medicine
Minutes No. 6 of 27.02.2018

Chairman dr. hab. , associated professor

Sergiu Suman _____

APPROVED
at the Council meeting of the Faculty Medicine nr. 2
Minutes No. 4 of 20.03.2018

Dean of Faculty dr., associated professor

Mircea Beţiu _____

APPROVED
approved at the meeting of the chair of Biochemistry and Clinical Biochemistry
Minutes No. 7 of 1.10.2017
Head of chair, dr. hab., associated professor

Olga Tagadiuc _____

SYLLABUS
DISCIPLINE CLINICAL BIOCHEMISTRY

Integrated studies

Type of course: Optional

Chisinau, 2017

I. INTRODUCTION

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

Clinical Biochemistry discipline aims to provide students with fundamental theoretical knowledge and general practical skills in medical biochemistry that are indispensable to all health professionals. Students will study the biochemical bases of the existence and functioning of the human body and of individual organs and systems under physiological conditions and in some diseases. Students will gain skills of individual and team work, of problem formulation and solving, of analysis and interpretation of the results of medical investigations, application of theoretical knowledge in medical practice, integration of information from different disciplines (fundamental and clinical), etc.

- Mission of the curriculum (aim) in professional training consists of studying:

a) the particularities of the chemical composition of some organs/tissues and of the fundamental metabolic processes underlying their functionality under physiological conditions;

b) disturbances in the chemical composition of organs/tissues and of the fundamental metabolic processes that underly the pathogenic mechanisms of organ/tissue damage in diseases;

c) biochemical investigation methods, the systemic and rational approach of biochemical diagnosis and the formation of critical analysis skills and of correct interpretation of laboratory data.

- Language (s) of the course: Romanian, English and Russian
- Beneficiaries: students of the 3rd year, Faculty of Medicine 2.

II. MANAGEMENT OF THE DISCIPLINE

Code of discipline		S.06.A.053	
Name of the discipline		Clinical biochemistry	
Person(s) in charge of the discipline		Olga Tagadiuc	
Year	III	Semester	VI
Total number of hours, including:			
Lectures	20	Practical/laboratory hours	
Seminars		Self-training	10
Form of assessment	C	Number of credits	1

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 particularities of the chemical composition of vital organs and tissues;
- to know the basic metabolic processes that ensure the viability of the organs and tissues;
- to know the influence of various factors (vitamins, pharmaceuticals, toxins) on the composition and metabolism of vital organs and tissues;
- to know the molecular mechanisms of the disorders that condition the major syndromes and diseases;
- to know the main methods of biochemical laboratory diagnosis;
- to study the normal values and physiological variations of the main biochemical markers;
- to know how to prepare patients for biochemical laboratory investigations, methods of collection, storage and transport of biological material and possible causes of errors.

b) at the application level:

- assess the clinical-diagnostic utility of certain biochemical investigations in the assessment of organ and tissue disorders;
- appreciate the usefulness of certain biochemical investigations in the diagnosis of specific conditions;
- systematically and rationally designate certain biochemical laboratory investigations based on presumptive diagnosis / patient diagnosis;
- to correctly interpret the results of biochemical investigations.

c) at the integration level:

- to appreciate the importance of Clinical Biochemistry in the context of General Medicine;
- know the correlations between Clinical Biochemistry and other clinical disciplines;
- objectifying the connections and interdependence between structural, metabolic and clinical biochemistry;
- to appreciate the evolution of physiological metabolic processes and their disorders that condition various pathologies;
- to correlate the pathogenic molecular-biochemical mechanisms of biochemical laboratory diagnosis metadowns useful in each particular case.

IV. PROVISIONAL TERMS AND CONDITIONS

Clinical biochemistry is a medical discipline, the study of which at the university stage will allow future physicians to know the molecular basis of physiological metabolic processes, biochemical mechanisms that are involved in the regulation of the organ/tissue and body functions, understand the causes and pathogenesis of hereditary and acquired diseases, the need for biochemical investigation and the rational and systemic use of specific markers, to undrstand the results of the laboratory examinations and to correlate them with clinical and functional data in

order to establish the diagnosis, life style correction and indication of therapies adapted to the pathology biochemical mechanisms.

To learn the discipline requires a thorough knowledge of Chemistry and Biology, obtained in high-school, as well as in the field of Anatomy, Histology, Human Physiology and Structural Biochemistry and Biochemistry obtained in the university.

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

V. THEMES AND ESTIMATE ALLOCATION OF HOURS

Lectures, practical hours/ laboratory hours/seminarsand self-training

No. d/o	THEME	Number of hours	
		Lectures	Self-training
1.	Practical aspects in clinical biochemistry. Clinical laboratory diagnosis. Preanalytical, analytical and postanalytical stages in biochemical laboratory diagnosis.	1	1
2.	The main methods for determining biochemical parameters in biological samples.	1	1
3.	Liver biochemistry. Liver enzymes and their diagnostic value. Metabolic functions of the liver. The role of liver in maintaining the body's homeostasis, in the production and excretion of the bile, and in the detoxification of endo- and exogenous compounds.	2	1
4.	The pathochemic pecculiarities of the main syndromes specific to hepatic disorders (hepatic cell failure syndrome, cytolytic syndrome, inflammatory syndrome and excreto-biliary syndrome) and their laboratory investigation.	2	1
5.	Thyroid hormones: regulation of synthesis and secretion, thyroid hormone transport and metabolism. Thyroid hormones receptors. Classification of thyroid disorders. Paraclinic exploration of the thyroid: evaluation of the thyroid gland's functional status; tests for thyroid autoimmunity; specific serum markers; biochemical constants in serum; dynamic evaluation and imaging of the thyroid.	2	1
6.	Hyperthyroidism and hypothyroidism: definition, causes and pathogenic mechanisms of excess or insufficiency of thyroid hormone production; metabolic changes and clinical manifestations of hyperthyroidism and hypothyroidism; paraclinic diagnosis and treatment principles.	3	1

No. d/o	THEME	Number of hours	
		Lectures	Self-training
7.	Lipoproteins: separation methods, types, functions, chemical composition. Apoproteins, enzymes and receptors involved in lipoprotein metabolism. Metabolism of lipoproteins. Investigation of lipid metabolism disorders.	2	1
8.	Primary and secondary hyper- and hypolipidemias: types, causes, clinical signs, biochemical diagnosis. Atherosclerosis. The role of lipoproteins in atherogenesis. Biochemical bases of hypolipidemic therapy.	2	1
9.	Fundamental principles of physico-chemical mechanisms involved in acid-base reactions (water properties, electrolyte dissociation, gas exchange principles). Buffer systems. The role of the lungs, kidneys, digestive tract in acid-base homeostasis.	2	1
10.	Investigation of the acid-base balance. Definition and classification of acid-base disorders. Laboratory diagnosis of acid-base balance disturbances. Non-diabetic (newborns, stress, alcohol, etc.) and diabetic ketoacidoses. Respiratory acidosis. Metabolic and respiratory alkalosis.	3	1
11.	Colloquy	1	
		20	10
Total		30	

VI. REFERENCE OBJECTIVES OF CONTENT UNITS

Chapter 1. Clinical laboratory diagnosis	
Objectives	Content units
1. Define the laboratory diagnosis. 2. Know biochemical laboratory research objects. 3. Identify the stages of laboratory investigations. 4. Determine the content and procedures specific to each stage. 5. Know and identify laboratory biochemical diagnosis errors and their causes. 6. Know and apply for themselves the standard profiles of the biochemical laboratory diagnosis.	1. Practical aspects in clinical biochemistry. 2. Clinical Laboratory Diagnosis - Definition and Directions. 3. Clinical biochemical laboratory diagnosis - definition, purpose. 4. Clinical and biochemical research objects. 5. Preanalytical stage of biochemical laboratory diagnosis:

7. Explain clinical and diagnostic value of biochemical markers.	– selection and request of the laboratory investigation; – selection of the optimal terms for the investigation; – preparation of the patient for the biological sampling; – correct collection of the biological sample, – primary processing, transport and storage. 6. Analytical stage in biochemical laboratory diagnosis: – special processing of the biological sample; – conducting the laboratory test; – quality control of investigations. 7. Post-analytical stage in biochemical laboratory diagnosis: – receiving the results of the investigation by the clinician; – interpretion of the results; – decision on the need for further testing. 8. The main methods for determination of biochemical parameters in biological samples.
Chapter 2. Biochemistry of the liver	
Objectives	Content units
1. Define lobulum, acin and hepatone and describe their metabolic peculiarities. 2. Classify liver enzymes and explain the diagnostic value of classes and individual representatives. 3. To distinguish the physiological changes of liver enzyme activity of diagnostic value from those conditioned by hepatic and extrahepatic diseases.	1. Morpho-functional characteristic of the liver and the biliary system. 2. Enzymatic liver profile and enzyme-diagnosis of liver disease. 3. Role of liver in intermediate metabolism (protein, carbohydrate and lipid) and maintenance of body homeostasis.

4. To systematically and rationally prescribe the investigation of hepatic enzmes activity in the diagnosis of liver diseases and their differentiation from extrahepatic diseases. 5. Know the role of the liver in the homeostasis of the protein, carbohydrate and lipid metabolism. 6. Identify laboratory markers of homeostatic liver function. 7. To apply the markers of liver homeostatic function in the biochemical diagnosis of liver diseases and extrahepatic pathologies. 8. Describe the pathogenic biochemical mechanisms of gallstone disease and the principles of treatment based on these mechanisms. 9. Differentiate types of hereditary and acquired jaundice based on changes in biochemical laboratory markers. 10. Descrive the detoxification / inactivation pathways of certain substances in the liver and the mechanisms of organ damage associated with detoxification / inactivation. 11. Define drug hepatopathy and know the mechanisms of conditionl development depending on the drug. 12. To know the markers specific to the liver pathologies syndromes (hepatic cell failure syndrome, cytolytic syndrome, inflammatory syndrome and excreto-biliary syndrome) and their diagnostic value. 13. To be able to prescribe systemic and rational the sets of markers for liver function investigation. 14. Appreciate correctly the changes in biochemical laboratory tests in some liver diseases. 15. Solve case studies.	4. Clinical-diagnostic value of the identification and dosing of plasma metabolites. 5. Liver excretion function: – the biological and patho-chemical role of bile acids; – metabolism of bile pigments and patho-chemical mechanisms of its disorders; – types of hyperbilirubinaemia and their laboratory diagnosis. 6. Detoxification mechanisms in the liver. Particularities of the oxido-reduction and conjugation phase. 7. Investigation of the liver function. Markers of syndromes specific to liver pathologies (hepatic cell failure syndrome, cytolytic syndrome, inflammatory syndrome and excreto-biliary syndrome). 8. Changes in hepatic biochemical tests in some liver diseases.
Chapter 3. Biochemistry of the thyroid gland	
Objectives	Content units

1. Describe in detail the metabolism of iodine in the body. 2. Know the particular mechanisms of synthesis, secretion, storage, transport and inactivation of T3 and T4. 3. Identify specific T3 and T4 receptors in tissues and organs, triggered signaling cascades, and metabolic processes subsequently regulated. 4. Classify disorders of thyroid function based on secretion level, type of glandular hypertrophy, and pathological condition etiology. 5. Define the causes of thyroid hypo- and hyperfunction. 6. Describe in logical sequence the chain of metabolic disorders in thyroid hypo- and hyperfunction and the mechanisms of organ and tissue damage. 7. Apply systemically and rationally according to specific algorithms the methods of laboratory investigation of thyroid function. 8. Appreciate correctly the changes in biochemical laboratory tests in thyroid dysfunctions. 9. Solve case studies.	1. Peculiarities of the thyroid hormones (T3 and T4) metabolism. 2. Classification of thyroid disorders based on secretion level, type of glandular hypertrophy and etiology. 3. Paraclinic exploration of the thyroid – Assessment of the functional status of the thyroid gland; – tests for thyroid autoimmune damage; – specific serum markers; – biochemical constants in serum; – radiocapture (RIC); – dynamic exploration of the thyroid function; – thyroid imaging - correlation with the results of the biochemical laboratory methods of investigation(generalities). 4. Algorithm for evaluation of the thyroid function. 5. Hyperthyroidism: definition; causes and mechanisms of overgrowth of thyroid hormone production; metabolic changes and clinical signs of hyperthyroidism; paraclinical diagnosis of hyperthyroidism; principles of treatment 6. Hypothyroidism: definition; causes and pathogenic mechanisms of thyroid hormone production deficiency; metabolic changes and clinical signs of hypothyroidism; paraclinic diagnosis of hypothyroidism; principles of treatment.
Chapter 4. Dyslipidemias	
Objectives	Content units

1. Define the notions of dyslipidemia, primary and secondary hyperlipidemia. 2. Know the principles of dyslipidemias classification and the corresponding classes. 3. Differentiate the causes that lead to the development of primary and secondary hyperlipidemias. 4. Explain logically the sequence of the pathogenic metabolic mechanisms of primary and secondary dyslipidemias. 5. Know the biochemical methods of diagnosis of dyslipidemias. 6. Systemically and rationally apply lipid metabolism assays. 7. Correctly evaluate changes in biochemical laboratory tests in some diseases accompanied by dyslipidemia. 8. Solve case studies.	1. Dyslipidemias - definition, classification (phenotypic, depending on cholesterol and TG levels) 2. Primary hyperlipoproteidemias - causes, mechanisms of development and metabolic, functional and morphological consequences. 3. Secondary hyperlipidemias: in diabetes, hypothyroidism, cholestasis and chronic alcoholism - mechanisms of development, metabolic, functional and morphological consequences. 4. Biochemical laboratory investigation of lipid metabolism and plasma lipoprotein disturbances. – screening tests; – analytical tests; – special tests.
Chapter 5. Acid-base, electrolyte and water balance	
Objectives	Content units
1. Define the concepts of acid-base equilibrium, compensated and decompensated metabolic and respiratory alkalosis and acidosis. 2. Know and describe the mechanisms of acidic equivalents production in the body. 3. Know the buffer systems and their mechanisms of action under physiological and pathological conditions. 4. Evaluate changes in buffer systems under different conditions by applying the Henderson-Hasselbalch equation. 5. Identify the connection between the mechanisms of maintaining the acid-base balance by the buffer systems and organs and tissues 6. Define the causes of acid-base equilibrium disturbances.	1. General principles of acid-base balance meintenance. 2. Mechanisms for control of H^+ concentration. – buffer systems; – physiological mechanisms. 3. Laboratory investigation of acid-base equilibrium - Astrup parameters. 4. Acid-base equilibrium disorders: – acidoses and alkaloids; – metabolic and respiratory; – compensated and decompensated.

7. Describe in logic consequence the mechanisms of the development of acid-base dissorders and of their compensation. 8. Correctly apply the laboratory methods to investigate acid-base balance. 9. To solve case studies.	

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

Professional (specific) (SC) competences

SC1. Knowledge, understanding and use of language specific to medical biochemistry.

SC2. General knowledge of key vital chemical compounds for the human body.

SC3. Explain the outcome of the main metabolic processes that ensure the viability of the body and the mechanisms of the most important disorders specific to major syndromes.

SC6. Advanced knowledge of the peculiarities of the chemical composition and metabolism of organs and tissues under physiological conditions and most important diseases.

Transversal competences (TC)

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

TC2. Individual and team work skills.

TC3. The ability to effectively apply information technology to medical activity as well as to identify 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:

1. know the structural and metabolic peculiarities of different organs and tissues in physiological conditions;
2. know the major mechanisms of the disorders that underline the most frequent syndromes and diseases;
3. know the normal values and the physiological changes of the main biochemical markers of different organs and tissues;
4. assess the usefulness of certain biochemical markers in the diagnosis of specific diseases and interpret correctly the results of biochemical investigations.
5. solve individual case studies in clinical biochemistry.

VIII. STUDENT'S SELF-TRAINING

No.	Expected product	Implementation strategies	Assessment criteria	Implementation terms
1.	Work with information sources	Selection of basic information and details regarding the study questions of the practical lesson by reading the lecture, the material in the MOODLE and additional information sources on the topic. Full reading of text and systematization of essential content. Generalization and making conclusions regarding the importance of the theme/subject.	Level of information assimilation and volume of work	During the semester
2.	Work with on-line materials	Studying the teaching materials on the Chair and other relevant sites, completing and acquiring information on the studied subject	Level of information assimilation and volume of work	During the semester
3.	Items for individual work and study cases solved	Self-solving of individual work items and study cases in accordance with the recommendations, with subsequent verification by the teacher in non-auditory hours.	Mark from 0-0.5 for each chapter. The ability to solve study cases for the particular cha pter is evaluated.	Each lesson
4	Self-assessment tests solved	Self-solving of the self-assessment tests in accordance with the recommendations, with subsequent verification by the teacher in non-auditory hours.	Mark from 0-0.5 for each chapter. The ability to solve tests for the particular chapter is evaluated.	Each lesson
5	Paper on actual topic presented at the students scientific	Selection of basic information and details on the current topics of biochemistry from scientific sources over the last 5 years.	Mark from 0-1.0 for each paper	During the year

	group of the chair and at national and international scientific conferences.			

VIII. METHODOLOGICAL SUGGESTIONS FOR TEACHING-LEARNING-ASSESSMENT

- Teaching and learning methods used.

The Clinical Biochemistry discipline teaching is based on classical and web-based training.

The course is held in accordance with the classical model. The theoretical teaching material and course presentations are placed on the MOODLE platform and are offered for individual study.

For individual works according to the methodological guidelines, tests and case studies are solved, interactive teaching and learning methods are applied.

To study the discipline, a number of learning methods such as observation, analysis, comparison, classification / scheme / figure design, modeling, deduction, and experiment are recommended.

- Applied teaching strategies / technologies (specific to the discipline)

Classical didactic strategies (inductive, deductive, analogous, algorithmic and heuristic) are applied in the teaching of the Clinical Biochemistry discipline, which are achieved by several teaching-learning methods (active participation, individual study, verification and evaluation) like description and didactic conversation, work with the tesx-book, problem solving, 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 idividual work.

- Methods of assessment

Current: Various current assessment methods are used for each topic that is studied: problem solving and testing, case study solving, etc.

Final: The final mark at the differential colloquy will consist of the average grade from the module (share 0.5) and the final computer-based test mark (share 0.5).

The average annual mark and the mark of final examination (computer assisted) - 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.

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.

Marks at different assessment stages

Intermediate marks scale (annual average, marks from the exam)	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	

IX. RECOMMENDED LITERATURE:

A. Compulsory:

1. www.e.usmf.md. (lecture course and theoretical material on the MOODLE platform).
2. https://themedicalbiochemistrypage.org

B. Additional:

1 Bhagavan N. V., Ha Chung-Eun. Essentials of Medical Biochemistry: With Clinical Cases. Academic Press; 1st edition, 2011.
2 Marshall W. J. Clinical Chemistry. 4th edition, Mosby press, UK, London, 2000