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.__ of _____
Chairman dr. hab. , associated professor

Sergiu Suman _____

APPROVED
at the Council meeting of the Faculty Medicine nr. 2
Minutes No.__ of _____

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 the Chair, dr. hab., associated professor

Olga Tagadiuc _____

SYLLABUS
DISCIPLINE LIVER BIOCHEMISTRY

Integrated studies

Type of course: Free choice discipline

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

Liver Biochemistry discipline aims to provide students with fundamental theoretical knowledge and general practical skills in liver biochemistry, which are indispensable to the professional work of medical staff, especially infectious diseases practitioners, hepatologists, transplantologists. Students will study the biochemical bases of liver function under physiological conditions, the role and mechanisms of organ intervention in maintaining body homeostasis, the methods of investigation of the organ condition and the systemic and rational approach of the biochemical evaluation of liver functions, metabolic mechanisms specific to the pathogenesis of some hepatobiliary diseases, syndromes specific to liver pathology and diagnostic algorithms for these syndromes. The activities during the discipline study will create individual and team work skills, ability to formulate and solve problem, analyse and interpret 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) peculiarities of the chemical composition of the liver and of the fundamental metabolic processes that underlie the function of the organ under physiological conditions;

b) disturbances in the chemical composition of the liver and the fundamental metabolic processes that are key pathogenic mechanisms of organ damage in pathology;

c) clinical biochemical investigation methods, the systemic and rational approach to biochemical diagnosis and the development of critical analytical skills and of correct interpretation of laboratory data in the assessment of liver structural and functional status.

Language (s) of the course: Romanian, English and Russian

Beneficiaries: students of the 3rd year, Faculty of Medicine 2.

II. ADMINISTRATION OF THE DISCIPLINE

Code of discipline		Fre choice	
Name of the discipline		Liver biochemistry	
Person(s) in charge of the discipline		Olga Tagadiuc	
Year	VI	Semestr/Semestrs	XI
Total number of hours, including:			60
Lectures	10	Practical/laboratory hours	12
Seminars	13	Self-training	25
Form of assessment	DC	Number of credits	**2**

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 peculiarities of the chemical composition of the liver;
- to know the fundamental metabolic processes that ensure the viability and normal function of the liver under physiological conditions;
- to know the influence of various factors (vitamins, medicines, dietary supplements, toxins) on liver composition and metabolism;
- to understand the molecular mechanisms of the disorders that condition the major syndromes and liver diseases and their complications;
- to understand the mechanisms of hepatic drug-mediated hepatic damage;
- to know the main biochemical diagnostic methods of the liver composition and functional status;
- to know normal values and physiological changes of the main hepatic biochemical markers;
- know how to prepare patients for biochemical laboratory investigations of liver function, methods of collection, storage and transport of biological material and possible causes of errors.

b) at the application level:

- to assess the clinical-diagnostic utility of certain biochemical investigations in the evaluation of the liver structure and function disorders;
- to appreciate the usefulness of certain biochemical investigations in the diagnosis of specific liver disorders as well as of their complications;
- to systematically and rationally prescribe certain biochemical laboratory investigations based on the presumptive diagnosis / final diagnosis of the patient;
- to correctly interpret the results of biochemical investigations.

c) at the integration level:

- to appreciate the importance of Liver Biochemistry in the context of General Medicine;
- to know the correlations between Liver Biochemistry and other clinical disciplines;
- to objectify the connections and interdependence between structural, metabolic, clinical and liver biochemistry;
- to evaluate the evolution of physiological metabolic processes and their disorders that condition various primary and secondary liver diseases;
- to correlate the biochemical molecular pathogenic mechanisms of liver diseases with biochemical laboratory diagnostic data used in each particular case.

IV. PROVISIONAL TERMS AND CONDITIONS

Liver biochemistry is a medical discipline, the study of which at the university stage will allow future physicians to know the molecular bases of physiological metabolic processes, biochemical mechanisms that regulate liver functions and the role of the organ in the homeostasis of the body, to

understand the causes and pathogenesis of hereditary and acquired, primary and secondary diseases of the organ, to argue the need for biochemical investigation and the rational and systemic use of specific markers, to interpret the results of the laboratory examination and to correlate them with clinical and functional data in order to establish diagnosis, to make life style correction and to prescribe therapies adapted to the biochemical mechanisms of hepato-biliary pathology.

To study the discipline is necessary thorough knowledge in the field of Chemistry and Biology, obtained in pre-university studies, as well as in the fields of Anatomy, Histology, Human Physiology, Pathology, Pharmacology and Structural, Metabolic and Clinical Biochemistry studied at the university level.

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

V. THEMES AND ESTIMATE ALLOCATION OF HOURS

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

No. d/o	THEME	Number of hours		
		Lectures	PH/S	Self-training
1.	Molecular particularities of the structural-functional organization of the liver (lobe, acin, hepatone). Hepatic cells - structural-functional and metabolic features. Their involvement in liver pathology.	1	1	1
2.	Liver enzymes. Classification, representatives, role and physiological variations.	1	2	3
3.	Mechanisms of disenzymia in liver diseases. Pathological changes of liver enzymes in liver and extrahepatic diseases. Hepatic enzyme value in the diagnostic, prognostic and monitoring of treatment of diseases.	1	3	3
4.	The role of liver in integrating metabolism and maintaining human body homeostasis. The role of liver in integrating basal metabolism (energy, carbohydrate, lipid and protein).	1	3	3
5.	The liver's role in maintaining electrolyte and water, acid-base balance, blood fluidity and vitamin homeostasis. Methods for investigating the integrative role of the liver and markers of metabolic disorders, water and electrolite, acid-base, fluid-coagulant equilibriums, etc. in hepatic diseases.	1	3	3
6.	Biliary excretion mechanisms and regulation of this process. Disorders of biliary excretion and associated pathologies. Methods for investigation of biliary excretion and markers of diagnostic value.	1	3	3
7.	Mechanisms of general and hepatic detoxification. Stages of detoxification in	2	3	3

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	the liver (oxidative and conjugation). Hepatotoxicity associated with detoxi-fcation mechanisms, including drug hepatoxicity. Markers of hepatotoxicity.			
8.	Biochemical syndromes specific to liver disease. Laboratory markers of each syndrome and their diagnostic value.	1	3	3
9.	Metabolic molecular mechanisms of hepatic diseases development. Specific laboratory markers.	1	3	3
10.	Differentiated colloquium	-	1	-
		10	25	25
	Total	60		

VI. REFERENCE OBJECTIVES OF CONTENT UNITS

Chapter 1. Structure-functional organization of the liver	
Objectives	Content units
1. Define the notions of lobe, acin, and hepaton. 2. Know the criteria for defining the lobe, acin and hepaton. 3. To know and to identify the compositional-metabolic characteristics of the lobe, acin and hepaton. 4. To characterize structural and functional the liver cells. 5. Know the structural-functional correlations of the liver with other organs. 6. Explain the pathogenic and clinical-diagnostic value of the structural-functional features of the liver.	1. The molecular particularities of the structural-functional organization of the liver. 2. The structural and functional characteristic of the lobe, acin and hepaton. 3. Hepatic cells - structural-functional and metabolic peculiarities. Their involvement in liver pathology. 4. Structural-functional correlations of the liver and other organs and tissues.
Chapter 2. Homeostatic function of the liver	
Objectives	Content units
1. Describe in detail the involvement of the liver in maintaining the metabolic homeostasis of the body. 2. To characterize the function and capacity of the liver storage and its impact on the body's homeostasis. 3. Describe the molecular mechanisms of liver involvement in maintaining the water-electrolite balance. 4. Know how to assess the water-electrolite metabolism disorders associated with hepato-	1. The role of liver in the integration of energy metabolism. 2. The role of liver in the integration of carbohydrate metabolism. 3. The role of liver in the integration of lipid metabolism. 4. The role of liver in the integration of protein metabolism. 5. The role of liver in maintaining vitamin homeostasis.

biliary diseases. 5. Describe the molecular mechanisms of liver involvement in maintaining acid-base balance. 6. Know how to assess the acid-base balance disturbances associated with hepato-biliary diseases. 7. Describe the molecular mechanisms of liver involvement in maintaining blood fluid- coagulant homeostasis. 8. Know how to assess the disorders of fluid-coagulant homeostasis associated with hepato-biliary diseases. 9. Know the markers of the homeostatic function of the liver. 10. Systemically and rationally use the markers of the liver's homeostatic function in the diagnosis of hepato-biliary diseases. 11. Solve case studies.	6. The role of the liver in maintaining water-electrolite and acid-base balance. 7. The role of liver in maintaining blood fluid-coagulant balance. 8. Methods of investigating the homeostatic role of the liver. 9. Markers of metabolic disorders, water-electrolite, acid-base, fluid-coagulant equilibrium, etc. in hepato-biliary diseases
Chapter 3. The excretion function of liver	
Objectives	Content units
1. To know the chemical composition of the bail under physiological conditions. 2. Describe in detail the mechanisms of bail formation. 3. Identify the factors that regulate biliary excretion. 4. Know the causes of the biliary excretion disorders. 5. Know the pathogenic molecular mechanisms of biliary lithiasis. 6. Apply systematically and rationally the methods of biochemical investigation of biliary excretion and markers of diagnostic interest. 7. Solve case studies.	1. Biliary excretion mechanisms. 2. Regulation of biliary excretion. 3. Disorders of biliary excretion. 4. Gall stone disease – causes, molecular pathocchemic mechanisms, diagnostic methods and treatment principles. 5. Biochemical markers of biliary excretion of diagnostic interest.
Chapter 4. The liver detoxification function	
Objectives	Content units
1. Define the notion of detoxication and inactivation. 2. Describe the general mechanisms of detoxification specific to the human organism and identify the role of the liver in this context.	1. General and hepatic detoxification mechanisms. 2. Oxidative stage of detoxification in the liver - the mechanisms, enzymes and coenzymes, final products and their

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3. Demonstrate the sequence of detoxification mechanisms in the liver. 4. Distinguish the detoxification specific pathways of individual compounds and factors involved. 5. Identify enzymes and coenzymes of detoxification and their role in drug metabolism. 6. To know the mechanisms of drug hepatotoxicity and methods of evaluation. 7. Solve case studies.	fate. The role of cit. P450. 3. Conjugation stage of detoxification in the liver - mechanisms, enzymes and coenzymes, compounds used in humans for conjugation, final products and their fate. 4. Liver toxic injury associated with detoxification mechanisms. 5. Hepatotoxicity of drugs - mechanisms, hepatotoxic drugs and methods of hepatotoxicity monitoring. 6. Markers of hepatotoxicity.
Chapter 5. Laboratory biochemical diagnosis in hepatobiliary pathology	
Objectives	Content units
1. Define biochemical syndromes specific to hepatic diseases - inflammatory, hepatocellular failure, cholestatic and cytolytic. 2. Identify the causes of syndromes specific to hepato-biliary diseases. 3. Explain the logical sequence of the pathogenic molecular mechanisms of hepato-biliary diseases development. 4. Identify the markers of each hepato-biliary diseases syndrome. 5. To know the changes of the hepatobiliary damage markers in various hepatic and extrahepatic diseases. 6. Systematically and rationally prescribe biochemical laboratory investigations in the diagnosis of hepato-biliary diseases. 7. Solve case studies.	1. Biochemical syndromes specific to liver diseases: inflammatory, hepatocellular failure, cholestatic and cytolytic - specific markers. 2. Diagnostic value of laboratory markers of each syndrome in various hepato-biliary diseases. 3. Molecular metabolic mechanisms of the most common liver disease. Specific laboratory markers

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. Knowledge of the specifics of chemical composition and liver metabolism under physiological

conditions and in various diseases.

SC3. Explaining the usefulness of biochemical methods of laboratory diagnosis in diagnostics, monitoring of treatment and assessing the prognosis of hepato-biliary 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 be able to:

1. to know the structural and functional peculiarities of the liver;
2. to identify the importance of liver in maintaining metabolic homeostasis (proteins, carbohydrates, lipids, nucleic acids and vitamins), water-electrolite, acid-base and fluid-coagulant balances;
3. to know the fundamental mechanisms underlining the specific functions of the liver - excretion and detoxification;
4. to know the normal values and the physiological changes of the main biochemical markers of liver function and syndromes characteristic for hepato-biliary diseases;
5. to assess the usefulness of certain biochemical investigations in the diagnosis of specific hepato-biliary diseases and correctly interpret the results of biochemical investigations;
6. individually solve case studies of liver biochemistry.

VIII. STUDENT'S SELF-TRAINING

No.	Expected product	Implementation strategies	Assessment criteria	Implementation terms
1.	Working with information sources	Selection of basic information and details on the questions of the topic by reading the lecture, the material in the manual and additional information sources on the topic. Full reading of text and systematization of essential content. Generali-zations and conclusions about the importance of the theme / subject.	Level of assimilation of information and volume of work	During the semester

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2.	Working with on-line information sources	Studying the teaching materials on the Department's website and supplementation of the information on the studied subject.	Level of assimilation of information and volume of work	During the semester
3.	Problem situations solved	Individual solving of problem situations in the subjects in accordance with the Practical Guide, with subsequent verification and individual discussion with the teacher in non-auditory hours.	Rating 0-0.5 for each	Every studied chapter
	Self-assess-ment tests solved	Individual solving of self-evaluation tests for the topic in accordance with the Practical Guide, with subsequent verification and individual discussion with the teacher at non-auditory hours.	Rating 0-0.5 for each	Every studied chapter

IX. METHODOLOGICAL SUGGESTIONS FOR TEACHING-LEARNING-ASSESSMENT

Teaching and learning methods used

Teaching of Liver Biochemistry discipline is organized in combination of classic methiods with web-based training.

The theoretical material and course presentations are placed on the MOODLE platform and are offered for individual study befor the lecture courses, laboratory work and seminars.

During the laboratory work and seminars theoretical subjects according to the methodological guidelines are discussed, tests and case studies are solved, interactive teaching and learning methods are applied.

For discipline study 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 teaching strategies (inductive, deductive, analogic, algorithmic and heuristic) are applied in the teaching of Structural Biochemistry. The strategies are achieved through several teaching and learning methods (active-participative, individual study, verification and assessment) such as exposure and didactic conversation, working with the text-book, theoretical problems and laboratory work, testing, etc. For the implementation of the strategies and methods, a set of technical means of training are used both in the courses and individual work.

- Methods of assessment

Current

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

Final

The final mark will consist of the average of the module mark (share 0.5) and the final computer-assisted exam (share 0.5).

The average annual mark and the marks of all the final exam stages (assisted by computer, test) - all will be expressed in numbers according to the scoring scale (according to the table), and the final mark obtained will be expressed in two decimal places to be passed in the note 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	

NOTE. 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.

X. 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

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