



CD 8.5.1 DISCIPLINE CURRICULUM

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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, professor, PhD

Suman Serghei _____

APPROVED

at the Council meeting of the Faculty Medicine
Minutes No. ___ of _____
Dean of Faculty Medicine No.2, associate professor, PhD

Bețiu Mircea _____

APPROVED

approved at the meeting of the Chair of Biochemistry and Clinical Biochemistry
Minutes No.1 of 25 august 2017
Head of chair, associate professor, PhD

Tagadiuc Olga _____

SYLLABUS DISCIPLINE THE CHEMICAL BASES OF LIVING MATTER

Integrated studies

Type of course: Free choice discipline

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 professional/specialty training program

The Chemical Bases of Living Matter discipline has purpose to initiate students in the main areas of chemistry with biomedical involvement, which are indispensable for carrying out medical studies in medicine, preventive medicine and dentistry. Students will be acquainted with the main groups of organic compounds of biomedical importance, the properties of these compounds and the types of chemical reactions they participate in.

The activities in the discipline study will create students' individual and team work skills, formulation and problem solving, working on certain laboratory equipment, application of general knowledge to the study of disciplines, integration of information from different disciplines (fundamental and clinical), etc.

Mission of the curriculum (aim) in professional training consists in studying of: a) the main groups of chemical compounds of biomedical importance and the physico-chemical properties of certain representatives; b) the importance of certain types of chemical reactions in metabolic processes of living organisms; c) training of analysis and synthesis skills, as well as application in the study of fundamental disciplines.

Languages of the course: Romanian, Russian, English.

Beneficiaries: students of the I year, Medicine faculty.

II. MANAGEMENT OF THE DISCIPLINE

Code of discipline			
Name of the discipline		The chemical bases of living matter	
Persons in charge of the discipline		Globo Pavel, Tagadiuc Olga	
Year	I	Semester/Semesters	2
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 principles of classification, nomenclature and isomerism of organic compounds;



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- to acquire the fundamental bases of theoretical organic chemistry that serve as a foundation for the structure studying and chemical reactivity of organic compounds;
- to know the spatial and electronic structure of organic molecules and the chemical transformations of substances involved in the vital processes, directly related to the knowledge of their biological functions;
- to assimilate the structure and chemical properties of the main classes of biologically active organic compounds.

b) at the application level:

- to classify organic compounds according to the structure of the carbon chain and the nature of the functional group;
- to identify the functional groups in the molecules of the organic compounds;
- to identify the sites of acidity and basicity in the molecules of organic compounds;
- to determine the conjugate and aromatic moieties in the organic molecules for identification of the chemical behaviour of organic substances;
- to have working habits in the organic chemistry lab, respecting the main rules of behaviour with toxic, flammable substances, acids and strong bases, with chemical equipment;

c) at the integration level:

- to appreciate the importance of discipline in the context of General Medicine;
- to know the correlations between disciplines as, The chemical bases of living matter and Structural biochemistry, as well as, Biochemistry and other fundamental disciplines;
- to appreciate the importance of abundance of certain conditions (t° , pH) for the ensure of structural and functional integrity of the biological compounds.

IV. PROVISIONAL TERMS AND CONDITIONS

The chemical bases of living matter is a discipline derived from organic chemistry and has purpose to familiarize students with the structure and properties of chemical compounds of biomedical significance, as well as the reactions to which they can participate and their role. Knowledge of the structure and properties of organic compounds will enable students to learn the biological substances in the human body more easily and in additional to understand their metabolic transformations, which being very varied and complex create some difficulties in their study, as well as understanding of their medical importance.

In order of understand the subject are required a thorough knowledge of the general and organic chemistry obtained in the pre-university schools.

Internet skills are also required to identify the sources needed for study and self-training work, document, tables and presentations processing.



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V. THEMES AND ESTIMATE ALLOCATION OF HOURS

No. d/o	THEME	Number of hours		
		Lectures	Practical hours	Self-training
1.	The electronic structure of atom. Electronic formulas. The periodic law and periodic table of elements.	1	3	2
2.	The chemical bond: covalent, ionic, metallic and hydrogen. The valence. Oxidation state.	1	2	2
3.	The structural theory of organic molecules. Classification of organic compounds.	1	2	2
4.	Spatial structure and stereoisomerism of organic compounds.	1	3	2
5.	Conjugation and aromaticity of heterocyclic systems. Electronic effects.	1	2	2
6.	Acidity and basicity of organic compounds.	1	2	2
7.	Classification of reagents and organic chemical reactions.	1	2	2
8.	Oxidation and reduction of organic compounds.	1	3	2
9.	Heterocyclic organic compounds – hydroxy and amino acids	1	2	2
10.	Biological active heterocyclic compounds.	1	2	2
11.	Differentiated colloquium		2	5
Total		10	25	25

VI. REFERENCE OBJECTIVES OF CONTENT UNITS

Objectives	Content units
Chapter 1. Chemistry fundamentals. The main concepts of organic chemistry	
1. To define the notions: nucleus, proton, neutron, electron, energy level, chemical bonding, covalent bond, polar and non-polar covalent bond, single bond, double bond, triple bond, ions, ionic bond, metal bond, hydrogen bonding. 2. To know the distribution of electrons on energetic levels, electronegativity, valence, possible degrees of oxidation.	1. The nuclear model of the atom. Nucleus, proton, neutron, electron, level of energy, electronegativity, oxidant, reductant. 2. The electron distribution of elements from periods I-IV. 3. The characteristics of the chemical elements (period I-III) according to their position in the periodic table of elements: symbol, periodic number, period, group, subgroup, atomic mass, atom structure, nucleus composition, maximum and minimum



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Objectives	Content units
<p>3. To prove the importance of the periodicity law and of the atom structure theory for understanding, explaining and predicting the properties of substances, periodic property changes of elements (metal and non-metallic); the correlation between composition and type of chemical bond of a substance (and vice versa).</p> <p>4. To apply the knowledge of atomic structure to characterize and predict the properties of the chemical element as a function to its position in the periodic table of elements.</p> <p>5. To define the notions: organic chemistry, organic substance, the main concepts of organic compounds chemical structure.</p> <p>6. To know the position of carbon in the periodic table of elements: element type, distribution of electrons on levels, valence, the possibility to form carbon chains, the nature of C-C, C-H bonds; skeletal and condensed structural formulas.</p> <p>7. To prove the differences between: the organic and the inorganic compounds according to their composition, source; the existence of multiple substances with the same molecular formula.</p> <p>8. To identify and distinguish the spatial structure of organic compounds.</p> <p>9. To know the stereoisomerism of the organic compounds.</p> <p>10. To know the types of conjugate systems.</p>	<p>valence, metal / nonmetal. The law of periodicity. The physical meaning of periodic law. The periodic changes of metallic and non-metallic properties of the elements from periods I-III.</p> <p>4. Chemical bond. Types of chemical bond: covalent, ionic, metallic, hydrogen. Single, double, triple bonds. The properties of substances with different types of chemical bonds.</p> <p>5. Organic substances: source, the specific composition (organogenic elements, molecules with the same molecular formula), diversity, the enormous number of compounds compared with inorganic ones. Their importance.</p> <p>6. The chemical structure theory of organic compounds and its importance. Isomers. Isomers.</p> <p>7. The carbon - the main element of organic compounds. The structure of the atom. Tetra-valence. Carbon chains. Structural formulas (skeletal and condensed formulas).</p> <p>8. The spatial structure of organic compounds.</p> <p>9. The conformation of open chain and cyclic compounds.</p> <p>10. The stereoisomerism of organic compounds. Enantiomers, diastereomers. Optical activity.</p> <p>11. Sterioisomerism of double bond compounds (π - diastereomers).</p> <p>12. Cyclic and open chain conjugated systems. The aromaticity of benzene and heterocyclic compounds.</p> <p>13. The polarization of covalent bonds. Electronic effects: inductive and mesomer. Electron-donor and electron-withdrawing substituents.</p> <p>14. The acidity and basicity of organic compounds.</p>



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Objectives	Content units
11. To know the properties of covalent bonds. 12. To know the acidity and basicity of organic compounds.	
Chapter 2. Notions of organic compounds reactivity – the basis of biologic functioning	
1. To know the classification of organic reactions according to their result and their mechanism. 2. To describe the electrophilic addition reactions in general and in concrete examples. 3. To describe the electrophilic substitution reactions in general and in concrete examples. 4. To describe the nucleophilic substitution reactions in general and concrete examples. 5. To describe the elimination reactions in general and concrete examples. 6. To describe nucleophilic addition reactions (aldehydes and ketones) in general and concrete examples. 7. To describe the oxidation and reduction reactions to general and concrete examples.	1. The classification of organic reactions by their result and their mechanism. Types of reagents. 2. The electrophilic addition reactions. The mechanism of hydrohalogenation and hydration reactions of conjugated alkenes and alkanes. 3. The electrophilic substitution reactions. The mechanism of helogenation and alkylation reactions of aromatic compounds. 4. The nucleophilic substitution reactions at sp^3 hybridized carbon atom. The hydrolysis reactions mechanism of halogenated and halogenated derivatives of alcohols. Alkylating reactions. Their biological importance. 5. The elimination reactions. The dehydrohalogenation reaction mechanism of halogenated and dehydrated alcohols. Biological importance. 6. The nucleophilic addition reactions to aldehydes and ketones. The addition mechanism reactions of carbonyl compounds with water, alcohols, thiols, primary amines. The aldol addition (condensation) and splitting reactions. Their biological importance. 7. The nucleophilic substitution reactions to carboxylic acids. The acylation reactions. Ester condensation. Acetylacetic ester. Coenzyme A. 8. The oxidation and reduction reactions of organic compounds.
Chapter 3. Poly- and hetero functionality of organic compounds. The precursors of the most important groups of medicines	
1. To know the amino alcohols. 2. To differentiate the hydroxy acids (mono-, bi- and tri- basic) and amino acids.	1. Aminoalcohols - representatives, structure, properties, the biological role. 2. Hydroxyacids (mono-, bi- and tri- basic) and amino acids. The specific reactions for α -, β -, δ - hydroxy and amino acids.



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Objectives	Content units
<ol style="list-style-type: none">To write the specific reactions for α-, β-, δ-hydroxy and amino acids.To differentiate oxoacids (aldehydes and ketoacids)To describe keto-enol tautomerism.To write the decarboxylation reactions of the ketones.To know the structure, properties and biological role of benzene functional derivatives.	<ol style="list-style-type: none">The oxo-acids (aldehydes and ketoacids). Keto-enol tautomerism. The decarboxylation reactions of ketones.The functional benzene derivatives.The heterocyclic systems of biological importance, with a heteroatom and their derivatives. The heterocyclic systems with several heteroatoms and their derivatives.

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

Professional (specific) competences (SC)

- SC1. Thorough knowledge, understanding and use of the specific language of organic chemistry.
- SC2. General knowledge of major organic compounds of biological significance.
- SC3. Advanced knowledge of the chemical properties of organic compounds of biological importance.
- SC4. The use of working technique at the main laboratory equipment (spectrophotometer, centrifuge, automatic pipette, pH meter).

Transversal competences (TC)

- TC1. Written and oral communication skills in the field of organic chemistry.
- TC2. Performing of activities and exercising of roles specific to team work. Promoting of the spirit of initiative, dialogue, cooperation, positive attitude and respect for others, empathy, altruism and continuous improvement of their own activities.
- TC3. The ability to apply effectively the information technologies in the medical activity as well as identification of the information and continuous education sources in the field of activity.
- TC4. Understanding and the ability to apply the principles and values of general and professional ethics.

Study outcomes

At the end of the course the student will be able to:

1. to know the structure and physico-chemical properties of the main chemical compounds of biological significance;
2. to know the main types of chemical reactions and their biological role;
3. to understand the importance of the chemistry study for the further learning of fundamental and clinical disciplines



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VIII. STUDENT'S SELF-TRAINING

No.	Expected product	Implementation strategies	Assessment criteria	Implementation terms
1.	The work with informational sources.	Selecting the main information and questions details during studying the lecture, the book and additional sources of information on corresponding theme The full reading of text and systematization of the essential content. Generalization on the importance of the topic / subject.	The level of information assimilation and work volume.	During the semester.
2.	Solutions of case study questions.	Solving the case study questions that corresponds to practical guidebook studied theme with followed discussion during seminar.	Evaluation.	Every theme.
3.	Solutions of auto evaluation tests.	Solving the auto evaluation tests that corresponds to practical guidebook studied theme.	Evaluation.	Every theme.
4.	The work with on-line sources.	Studying of chair's site didactic material and filing up the studied theme information.	The level of information assimilation and work volume.	During the semester.

IX. METHODOLOGICAL SUGGESTIONS FOR TEACHING-LEARNING-ASSESSMENT

Teaching and learning methods used

The Chemical Bases of Living Matter discipline is taught according to the classical university standard: courses, practical lessons and seminars.

The persons responsible of the discipline hold the course.

The laboratory experiments are carried out during practical lessons in order to acquire some easily accessible principles and methods of qualitative and quantitative chemical analysis. The work is finished by completing of the verbal processes and analysing of the obtained results.



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During seminars are discussed the theoretical subjects according to the methodical directions, are solved the tests and practical problems, are applied interactive methods of teaching and learning.

For better students' understanding of discipline are recommended a range of learning methods such as observation, analysis, and comparison, classification, drafting/analyzing of schema/figure, modeling, deduction, and experiment.

Applied teaching strategies / technologies

The classical didactic teaching strategies (inductive, deductive, analogic, algorithmic and heuristic) are applied in the teaching of The Chemical Bases of Living Matter discipline, which are achieved through several teaching-learning methods (active-participative, self-training study, verification and evaluation) such as exposure and didactic conversation, manual work, theoretical problem and laboratory work, test solving, etc.

For the implementation of the strategies and methods are used a set of technical means of training both during the courses and seminars, as well as during the practical lessons.

Methods of assessment (including the method of final mark calculation)

Current assessment: During each practical lesson and seminar are used several current assessment methods, like: control work papers, resolving of case-problems and quizzes, resolving of practical problems, etc.

The chemical bases of living matter' discipline has during the semester 3 tests.

Final assessment: The final mark will consist of the average score of three tests (ratio 0,5) and the final test in the computerized system (SIMU) (ratio 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	



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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.

X. RECOMMENDED LITERATURE:

A. Compulsory:

1. Tiukavkina N., Baukov I., Rucikin V. Chimia bioorganică. Chişinău: "Lumina", 1992.
2. Тюкавкина Н., Бауков Ю.. Биоорганическая химия. Москва: "Медицина", 2011.
3. Ivanov V., Cheptănaru C., Globa P. Chimie bioorganică, material didactic pentru studenții facultăților medicină generală, sănătate publică și stomatologie. Chişinău. Ed. Poligraf. Medicina. 2011

B. Additional:

1. Dinu V., Truția E., Popa-Cristea E., Popescu A. Biochimie medicală (mic tratat). București: "Editura medicală", 1997.
2. Руководство к лабораторным занятиям по биоорганической химии. Под. ред. Тюкавкиной Н. Москва: "Медицина", 1985.
3. Barbă N., Dragalina G., Vlad P. Chimie organică. Chişinău: "Știința", 1997.
4. Nenițescu C.D. Chimie organică. București: "Editura didactică și pedagogică", 1984.
5. Нейланд О.Я. Органическая химия. Москва: "Высшая школа", 1990.
6. Овчинников Ю. Биоорганическая химия. Москва: "Просвещение", 1987.
7. Моррисон Р., Бойд Р. Органическая химия (Пер. с англ.). Москва: "Мир", 1974.
8. Гауптман Ю., Грефе Х. Ремане. Органическая химия. (Пер. с нем.). Москва, 1979