

Academic programme
component

**31.05.01 General Medicine (in a
foreign language)**
programme

Б1.О.15
discipline code

SYLLABUS

Discipline Biochemistry

Author(s):

Mishanina L.A.

Director of Medicine and
Life Sciences Institute

PhD in Medical Sciences,
Docent

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Clinical Medicine Department

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Head of the department Krivenko O.G.

signature

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Clarification

Discipline volume: 9 credit points

1. Discipline (module) training results correlated with the indicators of competencies achievement determined by the educational programme

Competency	Indicators of competency achievement	Discipline (module) training results
УК-1 Can design action plans and apply systematic approach to critical analysis of problem situations	ИД-2УК-1 Collects, systematizes and critically analyzes information necessary to develop a strategy for resolving a problematic situation	To know: - the chemical and biological essence of the processes occurring in a living organism at the molecular and cellular levels; - the structure and properties of the main classes of biologically important compounds, the main ways of their transformation, the role of cell membranes and transport systems in metabolism in the body; - basic biochemical constants and their variability in pathological processes. To be able to: - interpret the results of biochemical studies; - to determine the pathological condition based on laboratory analysis data, to explain the mechanism of action of drugs and other substances on the human body; - interpret the results of the most common methods of laboratory and functional diagnostics. To have: - biochemical methods for examination of the patient. - skills in decoding laboratory analysis. - information on changes in biochemical parameters, taking into account the laws of the course of pathological processes.
ОПК-5 Can analyze morphofunctional and physiological indicators as well as pathological processes in human body to achieve professional goals	ОПК-5.2. Defines and analyzes morphological, functional, physiological states and pathological processes of the human body based on knowledge of biomolecules, subcellular cultures, their biochemical characteristics, metabolic pathways and principles of regulation	

2. Discipline contents

Topic 1. Introduction to biochemistry. Enzymes. Enzyme diagnostics. Biochemistry of nutrition and digestion.

Introduction to biochemistry. The history of the development of biochemistry.

Properties and classification of enzymes. The effect of temperature and pH on the activity of enzymes. The specificity of enzyme effects. Determination of enzyme activity. Structural and functional organization of enzymes. Regulation of enzyme activity. Classification of enzymes. Enzyme diagnostics.

Biochemistry of nutrition and digestion. Essential components of the diet. The biological role of vitamins. Digestion and absorption of proteins, lipids and carbohydrates.

Topic 2. Energy exchange. Metabolism and functions of carbohydrates

Energy metabolism and general pathway of catabolism. Oxidative decarboxylation of pyruvate. The tricarboxylic acid cycle. Mitochondrial respiratory chain. Oxidative phosphorylation. Metabolism and functions of carbohydrates. Anaerobic breakdown of glucose. Aerobic oxidation of carbohydrates is the main source of hydrogen donors for the respiratory chain and ATP generation. Apotomic breakdown of carbohydrates. Gluconeogenesis. Biosynthesis is the immobilization of glycogen. Structural polysaccharides. Genetic defects in carbohydrate metabolism.

Topic 3. The structure, properties and functions of proteins. Amino acid and protein metabolism

Introduction to biochemistry. Structure, classification and properties of amino acids. The primary structure of the protein. Levels of the structural organization of the protein molecule. The functions of proteins. The structure and functions of complex proteins. The structure and functions of myoglobin and hemoglobin. General pathways of catabolism and biosynthesis of amino acids. Decarboxylation, deamination and transamination of amino acids. The formation of ammonia in the body and the ways of its neutralization. Specific ways of amino acid metabolism. Features of glycine, serine, sulfur-containing and aromatic amino acids metabolism. Biosynthesis and breakdown of chromoproteins. Bilirubin metabolism and its disorders. Iron exchange. Biosynthesis of urea.

Topic 4. The structure, properties and functions of nucleic acids. Matrix syntheses

The exchange of nucleic acids. Enzymatic hydrolysis of nucleic acids in the gastrointestinal tract. Catabolism of purines and pyrimidines, end products of decomposition. Violation of uric acid synthesis. Gout. General schemes of anabolism of nucleotides: pyrimidine and purine ribonucleotides, biosynthesis of deoxyribonucleotides. Regulation of nucleotide biosynthesis. Matrix biosynthesis (DNA replication and transcription). Matrix biosynthesis (translation). Genetic code. Protein biosynthesis and its regulation.

Topic 5. Lipid metabolism and functions

Oxidation of higher fatty acids and glycerol in tissues. Biosynthesis of fatty acids. Biosynthesis of ketone bodies, triacylglycerols and phospholipids. The metabolism of cholesterol in the body. Lipoproteins. The relationship between lipid and carbohydrate metabolism.

Topic 6. Hormonal regulation of metabolism

General principles of metabolism regulation. The transmission of a hormonal signal to the cell. The hierarchy of the body's regulatory systems. Hormones of the hypothalamus and pituitary gland. Sex hormones. The biological role of adrenaline, glucagon, iodothyronines, glucocorticoids, mineralocorticoids, hormones regulating calcium metabolism and hormones of the posterior pituitary gland.

Topic 7. Structure and functions of biological membranes

The structure and functions of biological membranes. Liposomes as a model of biological membranes. Physico-chemical properties of the double phospholipid membrane (permeability, mobility of phospholipid molecules). Chemical heterogeneity of membrane phospholipids. Cholesterol. Specificity of the phospholipid composition of biological membranes. A dynamic model of Singer-Nicholson biological membranes. Peripheral and integral membrane proteins. Two-dimensional diffusion of proteins in membranes. Asymmetry of biological membranes.

Topic 8. Biochemistry of organs and tissues

Blood biochemistry. Blood plasma: components and their functions. The metabolism of red blood cells. The importance of biochemical blood analysis in the clinic. Liver biochemistry. Neutralization of toxic substances in the body. Biochemistry of kidneys and urine. Determination of normal and pathological components of urine. Micro express urine analysis. Biochemical research in the clinic.

3. Training support materials

- multimedia presentations on the discipline are available on MAU LMS Moodle;
- practical training manuals are available on MAU LMS Moodle;
- learning materials are available on MAU official website at «[Информация по образовательным программам, в том числе адаптированным](#)».

4. Discipline assessment materials

Discipline assessment materials is a separate document within the educational programme, it includes:

- a list of competencies indicating the stages of their achievement within the discipline;
- formative assessment tasks;
- interim assessment tasks;
- tasks for internal assessment of education quality.

5. The list of main and supplementary literature (printed, electronic and (or) electronic library resources)

Main literature:

1. Северин, Е. С. Биохимия : учебник / под ред. Е. С. Северина. - 5-е изд. , испр. и доп. - Москва : ГЭОТАР- Медиа, 2019. - 768 с. - ISBN 978-5-9704-4881-6. - Текст : электронный // ЭБС "Консультант студента" : [сайт]. - URL : <https://www.studentlibrary.ru/book/ISBN9785970448816.html>

2. Глухова, А. И. Биохимия с упражнениями и задачами : учебник / под ред. А. И. Глухова, Е. С. Северина - Москва : ГЭОТАР-Медиа, 2019. - 384 с. - ISBN 978-5-9704-5008-6. - Текст : электронный // ЭБС "Консультант студента" : [сайт]. - URL : <https://www.studentlibrary.ru/book/ISBN9785970450086.html>.

Supplementary literature:

3. Фоминых, В.Л. Биохимия : учебно-методическое пособие / В.Л. Фоминых, Е.В. Тарасенко, О.Н. Денисова ; ред. П.Г. Павловская ; Поволжский государственный технологический университет. – Йошкар-Ола : Поволжский государственный технологический университет, 2019.

6. Professional databases and information reference systems

- 1) University Library Online <https://biblioclub.ru/>
- 2) Electronic library “Student Consultant” <https://www.studentlibrary.ru/>

7. The list of licensed and openly distributed software, including domestic software

- 1) Microsoft Office 2007 Package
- 2) ABBYY FineReader Optical text recognition system

8. Ensuring mastering the discipline for people with special needs

Students with special needs are provided with printed and (or) electronic educational resources adapted to their needs.

9. The material and technical support of the discipline (module) is presented in the appendix to the academic programme "Material and technical conditions for the implementation of the educational programme" and includes:

- classrooms for conducting training sessions provided for by the specialty programme, fitted with technical equipment;

- spaces for self-study work fitted with computer equipment with the Internet connection and access to MAU LMS Moodle.

- biochemistry laboratory;

- PCR laboratory.

It is allowed to replace the equipment with its virtual counterparts.

Study load distribution by type of educational activity

Table 1 - Study load distribution

Educational activity	The discipline (module) study load distribution by the forms of training			
	Semester			In total
	2	3	4	
Lectures	8	20	20	48
Laboratory work	16	40	40	96
Seminars	84	48	12	144
Preparation for interim assessment	-	-	36	36
Total hours for the discipline	108	108	108	324
/ in the form of seminars	16	40	40	96
Interim and formative assessment				
Examination	-	-	+	+

The list of laboratory work topics on the forms of training

№	Laboratory work topics
1	2
1	pH effect of and temperature on enzyme activity
2	Activation and inhibition of enzymes
3	The specificity of the action of enzymes
4	Determination of the activity of the enzyme of the inner mitochondrial membrane – succinate dehydrogenase
5	Quantitative determination of amylase activity by the Wohlgemuth method
6	Quantitative determination of pepsin activity by the Pyatnitsky method
7	Quantitative determination of trypsin activity by a simplified method of formative titration

8	Quantitative determination of lipase activity
9	Quantitative determination of macroergic muscle compounds (ATP and creatine phosphate)
10	Qualitative reactions to carbohydrates
11	Quantitative determination of carbohydrates
12	Analysis of bile acids. Emulsification of fats
13	Determination of chemical indicators of the quality of dietary fats
14	Universal qualitative reactions to amino acids and proteins
15	Specific qualitative reactions to amino acids and proteins
16	Physico-chemical properties of proteins
17	Quantitative determination of water-soluble protein by photolorimetric biuretic macromethod
18	Quantitative determination of water-soluble protein by photolorimetric biuretic micromethod (using Benedict reagent)
19	Quantitative determination of water-soluble protein by the Lowry photolorimetric method
20	Proteins displacement
21	Determination of amino acid nitrogen by Sorensen formative titration
22	Qualitative reactions to water-soluble vitamins
23	Qualitative reactions to fat-soluble vitamins
24	Quantitative determination of vitamin C content in biological material by iodometric method
25	Quantitative determination of vitamin C in biological material in interaction with 2,6-dichlorophenolindophenol
26	Qualitative reactions to hormones