

Federal State Autonomous Educational Institution of Higher Education
«Peoples' Friendship University of Russia»

Medical Institute

Recommended MCSD

SYLLABUS
(STUDY GUIDE)

Subject

Biochemistry

Recommended for the direction of training (specialty)

31.05.01 General Medicine

Program (profile, specialization)

General Medicine

1. Program of the discipline: Biochemistry

1. Purpose of the discipline: to form the systematic knowledge about the molecular mechanisms of biological system functions, to accommodate creation of the base for the further study medical and clinical disciplines

2. Place of the discipline in the structure of

Biochemistry belongs to the general part (Block 1) of the educational plan

Table 1 shows the previous and subsequent disciplines aimed at the formation of discipline competencies in accordance with the competence matrix.

Prior and subsequent disciplines aimed at the formation of competencies

№ п/п	Competence Code and Name	Previous disciplines	Following disciplines
Universal Competence			
	UC-6	Biology, Chemistry	
	UC-1		Pathological physiology, clinical pathophysiology; Epidemiology
General Professional Competence			
	GPC-3	Chemistry	Medical elementology
	GPC-2 GPC-5	Biology	Medical elementology; Microbiology, Virology. Faculty therapy,
	GPC-10 GPC -11	Anatomy	Pharmacology. Internal medicine;

3. Requirements for the results of mastering the discipline:

A specialist's programme is to establish the following competences:

Formed competencies

Competence Code	Competence Name	Universal Competence Achievement Indicator Code and Name
UC-1.	Being able to implement critical analysis of problem situations based on systems approach, develop an action strategy	UC-1.1. Analysing scientific and technical literature and regulatory documents of medical institutions. UC-1.2. Assessing in a critical way the reliability of information sources, working with contradictory information from different sources.
UC-6.	Being able to identify and implement the priorities of their own activities and the ways of improving them based on self-assessment and lifelong learning	UC-6.1. Assessing their own resources and their (personal, contextual, time) limits; using them in an optimal way to successfully perform the assigned task. UC-6.2. Analyzing the results obtained in the course of their professional activity, carrying out self-control and self-analysis of the

		process and results of the professional activity, evaluating them critically, drawing objective conclusions on their work, defending their point of view in a right manner.
GPC-1	Being able to implement moral and legal norms, ethical and deontological principals in professional activity	GPC-1.1. Being able to abide by the ethical standards and legal regulations in professional activity. GPC-1.2. Being able to present professional information in the process of intercultural interaction observing the principles of ethics and deontology.
GPC-5.	Being able to assess morpho-functional, physiological conditions and pathological processes in the human body to solve professional tasks	GPC-5.1. Mastering the algorithm of clinical, laboratory and functional diagnosis when dealing with professional tasks. GPC-5.2. Being able to evaluate the results of clinical, laboratory and functional diagnosis when dealing with professional tasks. GPC-5.3. Being able to determine morpho-functional, physiological states and pathological processes of the human body.
GPC-10.	Being able to understand the operation principles of modern IT and use them to solve professional tasks	GPC-10.1. Being able to use information technology in professional activity.

As a result of study of discipline, a student must:

To know:

Safety rules for the work in biochemical laboratories with the reagents, instruments, animals;

physical and chemical nature of the processes occurring in living organisms at the molecular, cellular, tissue and organ levels;

structure and chemical properties of the major classes of biologically important organic compounds;

major metabolic pathways converting carbohydrates, lipids, amino acids, purine and pyrimidine bases, the role of cell membranes and transport systems in metabolism;

Structure and function of the most important chemical compounds (nucleic acids, natural proteins, and water-soluble vitamins, hormones, etc.);

physical and chemical methods of analysis in medicine (titration, chromatographic, spectrophotometric);

the role of biogenic elements and their compounds in living organisms;

Chemistry of hemoglobin, its participation in gas exchange and maintaining acid-base balance;

the theoretical foundations of computer science in medical and biological systems, the use of information and computer systems.

Be able to:

- analyze educational, scientific, popular science literature, the Internet and an educational portal for professional activities;

- critically assess the reliability of information sources

- determine and implement the priorities of their own activities and ways to improve them based on self-assessment

- to present professional information in the process of intercultural interaction, observing the principles of ethics and deontology

- to evaluate the results of clinical, laboratory and functional diagnostics in solving professional problems within the scope of the mastered program
- to determine the morpho functional, physiological states and pathological processes of the human body within the program of the subject
- use modern information and communication tools and technologies in professional activities
- use physical, chemical and biological equipment;
- make calculations based on the results of the experiment, carry out elementary statistical processing of experimental data;
- classify chemical compounds based on their structural formulas;
- to predict the direction and result of physicochemical processes and chemical transformations of biologically important substances;
- use the IUPAC nomenclature to compile names according to the formulas of typical representatives of biologically important substances;
- to distinguish in blood serum the normal values of the levels of metabolites (glucose, urea, bilirubin, uric acid, lactic and pyruvic acids, etc.) from pathologically altered ones, read the proteinogram and explain the reasons for the differences;
- to interpret the data of enzymodiagnostic studies of blood serum.
- use modern information and communication tools and technologies in professional activities

To master:

- the algorithm of clinical, laboratory and functional diagnostics in solving professional problems within the framework of the mastered program of the subject
- chemical and biochemical terminology;
- basic technologies for searching and transforming information, including using educational resources;
- the concept of limitations in the reliability and specificity of the most common laboratory tests;
- an algorithm for clinical, laboratory and functional diagnostics when solving professional problems
- the skills of making a preliminary diagnosis based on the results of biochemical studies of human biological fluids.

4. Total efforts and Employments

Total efforts ___7___ units.

Educational work	Hours (total)	Semester	
		3 (17 weeks)	4 (18 weeks)
Employments (total)	157	85	72
<i>including:</i>	-	-	-
Lectures	17	17	0
<i>Laboratory works (LW)</i>	140	68	72
<i>In the interactive form (IF):</i>	48	24	24
Individual employments (total)	95	59	36
Type of the intermediate grading		Intermediate examination	Final examination
Total efforts	hour	252	144
	unit	7	4
			3

5. Content of the discipline

5.1. Content of the items

N	Name of the item	Content of the item
1	Introduction. Proteins: structure, properties, functions. Complex proteins, Nucleic acids, Enzymes	Biomolecules. The most important problems of current biochemistry. Methods of investigations in biochemistry. Biochemistry and Medicine. Structure and Function of Biomolecules. Proteins - essential constituents of the living cells. Physical and chemical properties of proteins. Composition and properties of amino acids and peptides. Four levels of structural organization of proteins. The three-dimensional structure of proteins; role of domains and the relationship of proteins structure to their biological functions. Methods of isolation and purification of proteins. Classification of proteins: simple and conjugated proteins, composition and properties of individual representatives of conjugated proteins. Nucleic acids. Composition, structure and biological role of DNA and RNA. Enzymes: general properties, chemical structure, active centers, classification and nomenclature, allosteric enzymes. The mechanisms of enzymatic catalysis. Structure and function of coenzymes, Kinetics of enzymatic reactions and methods for determination of the enzyme's activity, Inhibitors of enzymes, Isoenzymes. Regulation of the enzyme activity, Diagnostic enzymology; enzymes as drugs.
2	Molecular mechanisms of regulation. Lipids: structure,	Vitamins: distribution, biological role, classification. Social basis of vitamin deficiency in some developing countries. Principles of vitamin therapy. Antivitamins. Composition and properties of individual representatives of the fat-soluble and

	properties, functions. Biological membranes	water-soluble vitamins: A, D, E, K, B1, B2, B6, B12, C, P, PP, H and Folic acid, Vitamin-like substances. Methods of quantitative determination of vitamins in the body. Hormones: hormone production in the endocrine glands. Molecular endocrinology. Mechanisms of hormonal regulation of metabolism and role of the second messengers, Chemical structure and properties of the main hormones. Hydrolysable lipids. Non-hydrolysable lipids. Biological roles. Fatty acids and fats. Triacylglycerols are the major fat in the human diet. Structure of phospholipids and glycolipids. Isoprenoids. Sterols. Steroid hormones. Bile acids.
3	Energy metabolism. Carbohydrate metabolism	Catabolism and anabolism. Methods of metabolism investigations. Types of metabolism and its regulation. Free energy of ATP hydrolysis. Biological oxidation-reduction reactions, Chemistry of digestion. Social aspects of the rational nutrition problems. Carbohydrate metabolism: pathways of absorbed monosaccharides. The pathway of glycogen synthesis and degradation. Anaerobic metabolism: glycolysis, glycogenolysis and gluconeogenesis. Aerobic metabolism: pentose phosphate pathway of glucose oxidation; oxidative decarboxylation. of pyruvate, the tricarboxylic acid cycle. Biological oxidation, The respiratory chain of electrons and protons transport, Oxidative phosphorylation. Energy effect of anaerobic pathways of carbohydrate metabolism. Hormonal regulation of carbohydrate metabolism. Pathology of carbohydrate metabolism,
4	Lipid metabolism	Lipid metabolism: pathways of the absorbed products lipid digestion, Mechanism of β -oxidation of fatty acids, Biosynthesis of fatty acids, triacylglycerols, phospholipids and cholesterol. Energy effect of lipid oxidation, Relationship between lipid metabolism and carbohydrate metabolism. Intracellular lipids and blood serum lipids. Regulation of lipid metabolism, Pathology of lipid metabolism.
5	Protein catabolism. Amino acid metabolism	Protein metabolism, 'dynamic state of body proteins, Nitrogen balance. Problems of adequate, balanced nitrogen nutrition. Proteolysis. Absorption and active transport of amino acids. Pathway of amino acids metabolism in the body: reactions of deamination, decarboxylation, transamination and hydroxylation. Degradation of tissue proteins. Urea cycle. Metabolism of individual amino acids. Regulation of protein metabolism, Pathology of protein metabolism, Relationship of protein metabolism with metabolism of lipids and carbohydrates.
6	Metabolism of complex proteins. Biochemistry of blood. Biochemistry of liver. Biochemistry of kidney and urine.	Metabolism of nucleoproteins and chromoproteins. Main features of heme. Heme synthesis and degradation. Distribution of iron. Purine synthesis and degradation. Gout. Pyrimidine synthesis and degradation. Blood: composition and functions. Cellular elements. Blood plasma: composition. Plasma proteins. Erythrocyte metabolism. Hydrogen ion concentration in the blood Plasma. Buffer systems in the plasma. Blood clotting. Fibrinolysis. Blood groups: the ABO system. Extracellular proteins. Metabolism of the collagens. Energy

		metabolism of the brain. Energy metabolism in the white and red muscle fibers. Functions of the kidneys. Urine formation. Organic components and Inorganic components of the urine. Functions in the acid–base balance: Proton excretion and Ammonia excretion. Electrolyte and water recycling.
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5.2. Items of the discipline and types of the works

№	Section	Lecture	LW	IW	Hours
	Section 2.				
1	Introduction to Biochemistry. Amino acids are monomers of protein molecules and peptides.	1	6	6	13
2	Proteins: structure, properties, functions	2	6	6	14
3	Nucleic acids, enzymes	2	8	6	16
	Section 2.				
4	Vitamins. Coenzymes	2	8	6	16
5	Lipids: structure, properties, functions. Biological membranes	2	8	7	17
6	Hormones. Molecular mechanisms of regulation and self-regulation.	2	8	7	17
	Section 3.				
7	Biological oxidation	2	8	7	17
8	Chemistry of carbohydrates	2	8	7	17
9	Carbohydrate metabolism	2	8	7	17
	Section 4.				
10	Lipid catabolism		8	4	12
11	Lipid anabolism		8	4	12
12	ROS. Xenobiotics.		8	4	12
	Section 5.				
13	Protein catabolism		8	4	12
14	Amino acid metabolism		8	4	12
15	Protein metabolism pathology		8	4	12
	Section 6.				
16	Synthesis and degradation of heme		8	4	12
17	Synthesis and degradation of nucleotides		8	4	12
18	Synthesis of nucleic acids and proteins. Biochemistry of the liver, blood and urine. Enzymodiagnosics		8	4	12
	Total	17	140	95	252

6. Laboratory practice

№	Discipline section number	Name of laboratory work	Трудоемкость (час.)
1			
1.1	Introduction to Biochemistry. Amino acids	Color reactions to proteins and amino acids. Protein precipitation.	6
1.2	Proteins: structure, properties, functions	Protein quantification. Plotting calibration curves. Protein dialysis. Amino acid chromatography on paper	6
1.3	Nucleic acids, enzymes	The action of amylase on starch. Effect of temperature on amylase activity. Determination of alkaline phosphatase	8

		activity	
2			
2.1	Vitamins.	Quantification of vitamin C in potatoes and vitamin P in tea.	8
2.2	Coenzymes. Lipid chemistry. Biological membranes	Spectrophotometric determination of NADH and calculation of the purity of a commercial preparation.	8
2.3	Hormones. Molecular mechanisms of regulation and self-regulation.	Influence of hormones on blood glucose.	8
3			
3.1	Biological oxidation	Quantification of pyruvate in urine.	8
3.2	Chemistry of carbohydrates	The specificity of the action of amylase and sucrase.	8
3.3	Metabolism of carbohydrates	Quantification of glucose. Plotting sugar curves.	8
4			
4.1	Lipid catabolism	Kinetics of lipase action.	8
4.2	Lipid anabolism	Determination of lecithins by Blur. Quantification of serum cholesterol.	8
4.3	ROS. Xenobiotics.	Determination of malondialdehyde.	8
5			
5.1	Protein catabolism	Quantitative analysis of gastric juice. Quantification of urea in urine. Quantification of urine creatinine.	8
5.2	Amino acid metabolism	Quantification of serum aminotransferase activity.	8
5.3	Protein metabolism pathology	Chromatographic methods for determination of transaminase activity and phenylalanine content in blood serum.	8
6			
6.1	Synthesis and degradation of heme.	Determination of bilirubin in blood serum.	4
6.2	Synthesis and degradation of nucleotides	Determination of uric acid in urine. Determination of the activity of succinate dehydrogenase in muscles.	6
6.3	Blood biochemistry. Biochemistry of the liver and kidneys Enzymodiagnosics	Quantification of serum cholinesterase and lactate dehydrogenase activities. Components of urine in normal and pathological conditions. Determination of amylase activity in urine.	14

7. Material support of the educational process

№	Subjects, disciplines (modules) in accordance with the curriculum	The name of the equipped classrooms, facilities for conducting practical activities with a list of the main hardware and / or software	Actual address of classrooms and facilities	Form of ownership, use (property, operational management,
1.	Biochemistry (testing)	Comp. classes of the Medical Institute	St. Miklukho-Maklay, 10	operational management
2.	Biochemistry (laboratory studies)	RUDN Advisory Fund: auditorium 329,330, 334, 336 (multimedia projector; personal computer, laboratory equipment *).	St. Miklukho-Maklay, 10	operational management

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1. Photoelectric Colorimeters,

2. centrifuges, thermo blocks,
3. measuring burets,
4. drying ovens,
5. analytical balances,
6. Magnetic stirrers.
7. Automatic pipettes with dispenser,
8. Chemicals and chemical glassware.

8. Knowledge Information

- 1) E-system RUDN
- 2) Pharmtest (department program)
- 3) Mentor (university program)
- 4) MyTestPro (department program)
- 5) SWISS-PROT, ENZYME(bases)
- 6) <https://www.ncbi.nlm.nih.gov/>

9. Educational and methodical literature

1. Baynes John W. Medical Biochemistry / J.W. Baynes, M.H. Dominiczak. - Fifth Edition ; Книга на английском языке. - London : Elsevier, 2019. - 682 p. : il. - ISBN 978-0-7020-7299-4 : 9587.68.
28.072 - B361
2. Ronner Peter. Netter`s Essential Biochemistry [Текст] / P. Ronner. - Книга на английском языке. - Philadelphia : Elsevier, 2018. - 482 p. : ill. - ISBN 978-1-929007-63-9 : 4833.40.
28.072 - R 773
3. Meisenberg Gerhard. Principles of Medical Biochemistry / G. Meisenberg, W.H. Simmons. - Fourth Edition ; Книга на английском языке. - London : Elsevier, 2017. - 617 p. : il. - ISBN 978-0-323-29616-8 : 5758.50.
28.072 - M 515
4. Clinical Biochemistry: Metabolic and Clinical Aspects / W.J. Marshall [и др.]. - 3rd Edition ; Книга на английском языке. - London : Elsevier, 2014. - 932 p. : il. - ISBN 978-0-7020-5140-1 : 10283.90.
52.5 - C 641
5. Baynes J. W. Medical Biochemistry / J. W. Baynes. - Third Edition ; Книга на английском языке. - London : Elsevier, 2009. - 653 p. : il. - ISBN 9780323053716 : 3659.65. 28.072 - B361
6. Т.Т. Berezov and B.F.Korovkiv. Biochemistry. – М., Mir Publishers. -1992. -515 p.
7. Kuznetsova O.M., Berezov T.T., Chernov N.N. Laboratory Manual on Biochemistry. Part 1. -Moscow: Digitpress.-2019. -58 p.
8. Kuznetsova O.M., Berezov T.T., Chernov N.N. Laboratory Manual on Biochemistry. Part 2. -М.: DIGITPRESS. -2018. -52 p.
9. Berezov T.T., Chernov N.N. Kuznetsova O.M. Collection of biochemistry tests. – М. Изд-во «Оргсервис-2000». -2011. - 60с.
10. Principles of Biochemistry 4nd ed./ Lehninger, A.L., Nelson, D.L., Cox, M.M. - Worth Publishing, 2004.
11. Principles of Medical Biochemistry 2nd ed./ Gerhard Meisenberg, William H. Simmons. - Mosby Elsevier, 2006
12. Reginald H. Garrett, Charles M. Grisham. Biochemistry, 6th Edition – 2017 ISBN: 9781305577206; -1280 p.

13. Основы биохимии: Учебное пособие для студентов медицинских вузов. – Под ред. Н.Н. Чернова, В.С. Покровского. – Москва: Е-нот, 2020. – 304 с.
14. Тестовые вопросы по биохимии для подготовки к экзамену: Учебное пособие для студентов медицинских вузов. – Под ред. Н.Н. Чернова, В.С. Покровского. – Москва: Е-нот, 2020. – 224 с.
15. Частная биохимия. Учебное пособие для студентов медицинских вузов. – Под ред. В.С. Покровского. – Москва: Е-нот, 2020. – 368 с.

10. Methodical instructions for the students to study the discipline

The study of the discipline is carried out in the following forms: lectures, laboratory studies and independent work of the student. Students are required to attend classes, complete assignments within the framework of classroom and independent work using recommended textbooks and teaching aids, electronic educational resources, databases, information and reference and electronic search systems.

The laboratory sessions provide training in targeted and interpersonal skills using appropriate laboratory equipment and multimedia.

Independent work outside the classroom can take place both in the classrooms of the department and in the computer class of the Medical Institute, where students can perform tasks based on materials developed by the teachers of the department. Extracurricular independent work includes the implementation of individual blocks of tasks formed and developed by the teacher, the preparation of messages on the proposed topics, preparation for the performance of tests (including in the form of tests).

Goals of independent work: systematization and consolidation of the obtained theoretical knowledge and practical skills; deepening and expanding theoretical knowledge; formation of the ability to use relevant literature; the formation of independence of thought, the ability to self-development, self-improvement and self-realization; development of research skills.

Educational materials in electronic form on a number of topics studied are posted on the department's website, in the personal accounts of employees on the RUDN University Training Portal, in TUIS, on the local resources of the RUDN University electronic library system. The study of the discipline assumes the presence of current, midterm controls and intermediate certification in the discipline.

12. Fund of assessment tools for intermediate certification of students in the discipline "Biochemistry".

Materials for assessing the level of mastering the educational material of the discipline "Biochemistry" (evaluation materials), including a list of competencies with an indication of the stages of their formation, a description of indicators and criteria for assessing competencies at various stages of their formation, a description of the assessment scales, typical control tasks or other materials, necessary for the assessment of knowledge, abilities, skills and (or) experience of activities that characterize the stages of the formation of competencies in the process of mastering the educational program, methodological materials that determine the procedures for assessing knowledge, skills, skills and (or) experience of activities that characterize the stages of formation of competencies, are developed in full and are available for students on the discipline page at TUIS RUDN.

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