Federal State Autonomous Educational Institution of Higher Education
PEOPLES' FRIENDSHIP UNIVERSITY OF RUSSIA NAMED AFTER PATRICE LUMUMBA
RUDN University

Institute of Medicine

educational division (faculty/institute/academy) as higher education programme developer

COURSE SYLLABUS

BIOCHEMISTRY

course title

Recommended by the Didactic Council for the Education Field of:

31.05.01 GENERAL MEDICINE

field of studies / speciality code and title

The course instruction is implemented within the professional education programme of higher education:

31.05.01 GENERAL MEDICINE

higher education programme profile/specialisation title

2026г.

1. COURSE GOALS

The discipline "Biochemistry" is included in the program of the specialty "Medicine" in the direction 31.05.01 "General Medicine" and is studied in the 3rd, 4th semesters of the 2nd year. The discipline is implemented by the Department of Biochemistry named after academician T.T. Berezov. The discipline consists of 6 sections and 18 topics and is aimed at studying basic information about the properties of chemical compounds that make up biological organisms, their transformations and regulation.

The purpose of mastering the course "Biochemistry" is the formation of systemic knowledge about the molecular mechanisms of the functioning of biological systems; about the structure and properties of chemical compounds that make up living organisms, about the main patterns of biochemical processes and the mechanisms of their regulation; creation of a theoretical base for further study of biomedical and clinical disciplines.

2. REQUIREMENTS FOR LEARNING OUTCOMES

Mastering the discipline "Biochemistry" is aimed at developing the following competencies (parts of competencies): GPC-5.

Table 2.1. List of competences that students acquire through the course study

Competence code	Competence descriptor	Competence formation indicators
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, including using of artificial intelligence technologies. GPC-5.3. Being able to determine morpho-functional, physiological states and pathological processes of the human body.

3.COURSE IN HIGHER EDUCATION PROGRAMME STRUCTURE

The course refers to the core/variable/elective component of (B1) block of the higher educational programme curriculum.*

* - Underline whatever applicable.

Within the higher education programme students also master other (modules) and / or internships that contribute to the achievement of the expected learning outcomes as results of the course study.

Table 3.1. The list of the higher education programme components/disciplines that contribute to the achievement of the expected learning outcomes as the course study results

Competence code	Competence descriptor	Previous courses/modules*	Subsequent courses/modules*
GPC-5	Being able to assess morpho-functional, physiological	Biology; Chemistry;	General surgery; Obstetrics and gynecology;

	conditions and pathological processes in the human body to solve professional tasks	Bioorganic chemistry; Anatomy; Histology, embryology, cytology;	Microbiology, virology; Oncology, radiation therapy. Pathophysiology, clinical pathophysiology; Molecular genetic methods; Methods of microbiological diagnostics; Propaedeutics of internal diseases; Immunology; Pathological anatomy, clinical pathological anatomy; Radiation diagnostics; Medical Elementology; Phthisiology; Anesthesiology, Resuscitation, Intensive Care; Ophthalmology; Methods of cell biology and histology; Pharmacology; Topographic anatomy and operative surgery; Forensic medicine; Maxillofacial surgery; Medical forensics; Otorhinolaryngology; Pediatrics; Sectional course;

* To be filled in according with the competence matrix of the higher education programme.

4. COURSE WORKLOAD AND ACADEMIC ACTIVITIES

The total workload of the course is 2 credits (72 academic hours).

*Table 4.1. Types of academic activities during the periods of higher education programme mastering (**full-time training**)**

Type of academic activities		**Total academic hours**	**Semesters/training modules**	
			3	**4**
Contact academic hours		***157***	***85***	***72***
including:				
Lectures (L)		17	17	0
Lab work (LW)				
Seminars(S)		140	68	72
Self-studies		*32*	*14*	*18*
Evaluation and assessment (exam/passing/failing grade)		*27*	*9*	*18*
Course workload	academic hours	**216**	**108**	**108**
	credits	**6**	**3**	**3**

5. COURSE CONTENTS

Table 5.1. Course contents and academic activities types

Course module title	Course module contents (topics)	Academic activities types
Section 1 Introduction. Structures and functions of macromolecules.	1.1 Amino acids. Proteins Amino acids. Proteins: structure, properties, functions. Protein purification methods. Folding and intracellular degradation of proteins. Complex proteins: hemoglobin, immunoglobulins. The use of artificial intelligence technologies to study proteins, predict their properties and create molecules with specified properties.	L, S
	1.2 Carbohydrates. Nucleic acids Carbohydrates: structure, functions, classification, properties. The concept of glycobiology, protein glycosylation. Nucleic acids. The concept of genomics. Matrix biosynthesis: replication, transcription, translation	L, S
	1.3 Lipids. Cell membranes Lipids: structure, functions. Cell membranes: proteins and lipids of membranes& Membrane transport.	L, S
Section 2 Enzymology and principles of signal transmission	2.1 Enzymes Structure of enzymes and classification. Active cite. Allosteric enzymes. Cofactors and coenzymes. Isoenzymes. Enzymatic kinetics.	L, S
	2.2 Mechanisms of regulation of enzyme activity Mechanisms of regulation of enzyme activity: covalent modifications and intracellular enzyme concentration. Enzyme inhibitors and activators. Enzymes in medicine.	L, S
	2.3 Principles of signal transduction. Signal molecules. Classification of hormones. Principles of signal transduction. The concept of second messengers. Regulation of gene expression	L, S
Section 3 Energy metabolism and carbohydrate metabolism	3.1 Introduction to metabolism Fundamentals of bioenergetics and metabolism Fundamentals of bioenergetics and metabolism. Synthesis of ATP. Oxidative phosphorylation and substrate level phosphorylation. Mitochondrial diseases. Citrate cycle. ROS and oxidative stress.	L, S
	3.2 Digestion and transmembrane transport of carbohydrates. Glucose homeostasis. Phosphorylation of glucose. Possible pathways for the conversion of glucose-6-phosphate Aerobic and anaerobic glycolysis. Energy effect. Gluconeogenesis.	L, S
	3.3 Pentose pathway of glucose oxidation, fructose, and galactose metabolism. Glycogen metabolism. Regulation of carbohydrate metabolism. PPP, fructose, and galactose metabolism. Glycogen metabolism. Regulation of carbohydrate metabolism. Glycogen storage diseases. Disorders of carbohydrate metabolism in diabetes mellitus and metabolic syndrome.	L, S
Section 4 Lipid metabolism.	4.1 Digestion, absorption, and transport of lipids. Synthesis of FFA and oxidation of FFA	S

Course module title	Course module contents (topics)	Academic activities types
	Digestion, absorption, and transport of lipids. Bile acids. Dyslipidemia. Synthesis of FFA and oxidation of FFA. Energy effect of FFA oxidation.	
	4.2 Synthesis of complex lipids. Synthesis and degradation of TAG. Fatsoluble vitamins Synthesis of complex lipids. Synthesis and degradation of TAG. Lipolysis in adipocyte, regulation, oxidation of glycerol. Phospholipids. Eicosanoids. Fat soluble vitamins.	S
	4.3 Sphingolipids. Cholesterol. Sphingolipids, ceramides, and glycosphingolipids. Cholesterol synthesis and regulation. Lipid metabolism disorders.	S
Section 5 Metabolism of amino acids and simple proteins.	5.1 Digestion of proteins. Common pathways of amino acid metabolism. Digestion of proteins, absorption of products. Common pathways of amino acid metabolism: transamination, decarboxylation, deamination of amino acids. Types of deamination.	S
	5.2 Detoxification of ammonia in the body. Detoxification of ammonia in the body. Transport forms of ammonia. Urea cycle. Synthesis of biogenic amines. MAO and COMT.	S
	5.3 Metabolism of individual amino acids Metabolism of individual amino acids. Reactions of methylation and hydroxylation. Synthesis of epinephrine. Synthesis of creatine phosphate. Amino acid metabolism disorders	S
Section 6 Metabolism of complex proteins. The integration of metabolism. Clinical biochemistry.	6.1 Heme. Purine and pyrimidine nucleotides. Synthesis and degradation of heme. Synthesis and breakdown of purine and pyrimidine nucleotides. Goat, Lesh-Nyhan syndrome, orotic aciduria.	S
	6.2 Integration of metabolism Integration of metabolism. Principles of hormonal regulation of basic metabolic processes.	S
	6.3 Features of the metabolism of individual organs and systems Features of the metabolism of individual organs and systems. Metabolic changes during fasting. The role of vitamins and microelements in metabolic processes. Biochemical analyzes of blood and urine in normal and pathological conditions. Application of artificial intelligence technologies for the analysis of laboratory parameters.	S

* - to be filled in only for **full** -time training: *LC - lectures; LW - lab work; S - seminars.*

6. CLASSROOM EQUIPMENT AND TECHNOLOGY SUPPORT REQUIREMENTS

Table 6.1. Classroom Infrastructure and Technology Support Requirements

Type of academic activities	Classroom equipment	Specialised educational / laboratory equipment, software, and materials for coursestudy (if necessary)
Lecture	An auditorium for conducting lecture-type classes, equipped with a set of specialized furniture; a blackboard (screen) and technical means of multimedia presentations.	Projector and laptop
Lab-work	An auditorium for laboratory work, individual consultations, routine monitoring and intermediate certification, equipped with a set of specialized furniture and equipment.	A set of specialized furniture, a ProfMT laboratory medical centrifuge, an ATLANT XM 6026-031 refrigerator, an AR0640 electronic scale from Ohaus Europe, a Hitachi F-2700 spectrophotometer, a GTL-200 distiller, a thermostat, a PE-4030 36-port thermoblock, 23 x 45 mm diameter, a U-2900 dual-beam spectrophotometer, and an L7-55 centrifuge.
Self-studies	Classroom, equipped with a set of specialized furniture; whiteboard; a set of devices includes portable multimedia projector, laptop, projection screen, stable wireless Internet connection. (classroom 203)	An auditorium for students to work independently (can be used for seminars and consultations), equipped with a set of specialized furniture and computers with access to e-system.

7. RECOMMENDED SOURCES FOR COURSE STUDIES

Main reading:

1. Biochemistry with exercises and tasks: textbook / editors by A. I. Glukhov, V. V. Garin. - Электронные текстовые данные. - Moscow: GEOTAR-Media, 2022. - 296 p. : ill. - Книга на английском языке. - ISBN 978-5-9704-7069-5. https://mega.rudn.ru:443/MegaPro/UserEntry?Action=Rudn_FindDoc&id=518499&idb=0
2. Baynes J.W., Dominiczac M.H. Medical Biochemistry. - Fifth Edition; - London: Elsevier, 2019. - 682 p.
3. Berezov T.T.
Biochemistry / T.T. Berezov, B.F. Korovkin ; Transl. from the Russian by B.V.Rassadin. - Moscow : Mir, 1992. - 515 p. : il. - ISBN 5-03-001650-3 : 35.00.

Additional readings:

1. Netter`s Essential Biochemistry / P. Ronner. - Книга на английском языке. - Philadelphia : Elsevier, 2018. - 482 p. : ill. - ISBN 978-1-929007-63-9 : 4833.40.
2. 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.
3. Clinical Biochemistry: Metabolic and Clinical Aspects / W.J. Marshall, M. Lapsley, A.P. Day, R.M. Ayling. - 3rd Edition ; Книга на английском языке. - London : Elsevier, 2014. - 932 p. : il. - ISBN 978-0-7020-5140-1 : 10283.90.
4. Harper’s Illustrated Biochemistry 30th ed./ Victor W. Rodwell, David A. Bender, Kathleen M. Botham, Peter J. Kennelly, P. Anthony Weil / McGraw-Hill Education, 2015.

1. *Internet sources*

Electronic libraries (EL) of RUDN University and other institutions, to which university students have access based on concluded agreements:

RUDN Electronic Library System (RUDN ELS) http://lib.rudn.ru/MegaPro/Web
- EL "University Library Online" http://www.biblioclub.ru
- EL "Юрайт" http://www.biblio-online.ru
- EL "Консультант студента" www.studentlibrary.ru
- EL "Троицкий мост"

2. *Databases and search engines:*

- electronic foundation of legal and normative-technical documentation http://docs.cntd.ru/
- Yandex search engine https:// www .yandex.ru/
- Google search engine https://www.google.ru/
- Scopus abstract database http://www.elsevierscience.ru/products/scopus/

3. *Learning toolkits for self-studies during the development of the discipline*

* - All teaching materials for self-studying of students are placed in accordance with the current procedure on the discipline page in the RUDN LMS TUIS.

8. EVALUATION TOOLKIT AND GRADE SYSTEM FOR ASSESSMENT

The assessment toolkits and the grade system to evaluate the level of competences (GPC-5) formation as on the results of mastering the discipline "Biochemistry" are presented in the Appendix to this Work Program of the discipline.

* The assessment toolkit and the grade system are formed based on the requirements of the relevant local normative act of RUDN University (regulations / order).

DEVELOPERS:

Associate Professor, Department of Biochemistry named after Academician T.T.Berezov		O.M.Kuznetsova
Position, department	Signature	Name

HEAD OF THE DEPARTMENT:

Department of Biochemistry named after Academician T.T.Berezov		V.S.Pokrovsky
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