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**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:

General Medicine

higher education programme profile/specialisation title

2024г.

1. COURSE GOALS

The goal of the course "Biochemistry" is to form 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 course (module) "Biochemistry" is aimed at the development of the following competences /competences in part: UC-1.1; UC-1.2; UC-6.1; UC-6.2; GPC-1.1; GPC-1.2; GPC-5.1; GPC-5.2; GPC-5.3; GPC-10.1.

Table 2.1. List of competencies that contribute to expected learning outcomes

Competence code	Competence descriptor	Competence formation indicators
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. Analysing 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	GPC-5.1. Mastering the algorithm of clinical, laboratory and functional diagnosis when dealing with professional tasks.

	processes in the human body to solve 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	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.

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*
UC-1	Being able to implement critical analysis of problem situations based on systems approach, develop an action strategy	Anatomy Physics Philosophy Biology	Topographic anatomy and operative surgery Pathophysiology, clinical pathophysiology Hygiene Propaedeutics of internal diseases Public health and healthcare, health economics Neurology, medical genetics, neurosurgery Medical Elementology Epidemiology Faculty therapy Infectious diseases Hospital therapy Endocrinology Anesthesiology, intensive care, intensive care Allergology Disaster Medicine Phthisiology Medical Enzymology Experimental oncology

Competence code	Competence descriptor	Previous courses/modules*	Subsequent courses/modules*
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.	Physics Biology Chemistry Bioorganic chemistry Psychology and Pedagogy	Medical Enzymology Introduction to the Specialty
GPC-1	Being able to implement moral and legal norms, ethical and deontological principals in professional activity	Biology Anatomy History of Medicine Law Science	Propaedeutics of internal diseases General surgery Faculty Surgery Otorhinolaryngology Urology Professional Diseases Forensic medicine Anesthesiology, intensive care, intensive care Oncology, radiation therapy Endoscopic urology Medical Enzymology Practice to Gain Primary Professional Skills and Professional Experience: Assistant Ward Nurse Medical forensics
GPC-5	Being able to assess morpho-functional, physiological conditions and pathological processes in the human body to solve professional tasks	Biology Histology, embryology, cytology Anatomy Molecular Genetics in Practical Biology and Medicine	Pathological anatomy, clinical pathological anatomy. Microbiology, virology Topographic anatomy and operative surgery. Pathophysiology, clinical pathophysiology Dermatovenerology. Neurology, medical genetics, neurosurgery. Faculty therapy. Faculty surgery. Obstetrics and gynecology. Ophthalmology. Professional diseases. Psychiatry, medical psychology. Hospital therapy. Hospital surgery, pediatric surgery. Forensic medicine. Anesthesiology, Resuscitation, Intensive Care.

Competence code	Competence descriptor	Previous courses/modules*	Subsequent courses/modules*
			Oncology, radiation therapy. Maxillofacial surgery. Reproductive health. Medical enzymology. Fundamentals of integrative medicine. Practice in the Therapeutic Field: Physician's Assistant Molecular genetic methods Methods of cell biology and histology Methods of microbiological diagnostics Medical forensics General surgery;
GPC - 10	Being able to understand the operation principles of modern IT and use them to solve professional tasks	Mathematics Medical Informatics	Pharmacology Radiology General surgery Faculty Surgery Medical rehabilitation Professional diseases Anesthesiology, Resuscitation, Intensive Care. Biostatistics Telemedicine Medical Enzymology Modern methods of medical statistics

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

4. COURSE WORKLOAD AND ACADEMIC ACTIVITIES

The total workload of the course is 7 credits (252 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
<i>Contact academic hours</i>	157	85	72
including:			
Lectures (LC)	17	17	-
Lab work (LW)	140	68	72
Seminars (workshops/tutorials) (S)			
<i>Self-studies</i>	50	41	18
<i>Evaluation and assessment (exam/passing/failing grade)</i>	45	27	18

Type of academic activities		Total academic hours	Semesters/training modules	
			3	4
Course workload	academic hours	252	144	108
	credits	7	4	3

* To be filled in regarding the higher education programme correspondence training mode.

5. COURSE CONTENTS

Table 5.1. Course contents and academic activities types

Course module title	Course module contents (topics)	Academic activities types
Module 1 Structures and functions of macromolecules. Proteins. Nucleic acids. Lipids. Carbohydrates.	Topic 1.1. Introduction to biochemistry. Amino acids. Proteins: structure, properties, functions. Protein purification methods. Folding and intracellular degradation of proteins. Complex proteins: hemoglobin, immunoglobulins	LC, LW
	Topic 1.2. Carbohydrates: structure, functions, classification, properties. The concept of glycobiology, protein glycosylation. Nucleic acids. The concept of genomics. Matrix biosynthesis: replication, transcription, translation	LC, LW
	Topic 1.3. Lipids: structure, functions. Cell membranes.	LC, LW
Module 2 Enzymology and signal transduction principles	Topic 2.1. Enzymes. Active site. Allosteric enzymes. Cofactors and coenzymes. Isoenzymes. Enzymatic kinetics.	LC, LW
	Topic 2.2. Mechanisms of regulation of enzyme activity. Enzyme inhibitors. Classification of enzymes.	LC, LW
	Topic 2.3. Principles of signal transduction. The concept of second messengers. Regulation of gene expression	LC, LW
Module 3 Energy metabolism and carbohydrate metabolism	Topic 3.1. Introduction to metabolism. Fundamentals of bioenergetics and metabolism. Synthesis of ATP. Oxidative phosphorylation. Mitochondrial diseases. TCA.	LC, LW
	Topic 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.	LC, LW
	Topic 3.3 PPP, fructose, and galactose metabolism. Glycogen metabolism. Regulation of carbohydrate metabolism. Disorders of carbohydrate metabolism in diabetes mellitus and metabolic syndrome.	LC, LW

Course module title	Course module contents (topics)	Academic activities types
Module 4 Lipid metabolism.	Topic 4.1. Digestion, absorption, and transport of lipids. Bile acids. Dyslipidemia. Synthesis of FFA and oxidation of FFA. Energy effect of FFA oxidation.	LW
	Topic 4.2. Synthesis of complex lipids. Synthesis and degradation of TAG. Lipolysis, oxidation of glycerol. Phospholipids. Eicosanoids. Fat soluble vitamins.	LW
	Topic 4.3. Sphingolipids, ceramides, and glycosphingolipids. lipid metabolism disorders.	LW
Module 5 Amino acid metabolism.	Topic 5.1. Common pathways of amino acid metabolism: transamination, decarboxylation. deamination of amino acids. Types of deamination.	LW
	Topic 5.2. Detoxification of ammonia in the body. Urea cycle. Synthesis of biogenic amines. MAO and COMT.	LW
	Topic 5.3. Metabolism of individual amino acids. Reactions of methylation and hydroxylation. Synthesis of epinephrine. Synthesis of creatine phosphate. Amino acid metabolism disorders	LW
Module 6 Metabolism of complex proteins Metabolic integration. Clinical biochemistry.	Topic 6.1. Synthesis and degradation of heme. Synthesis and breakdown of purine and pyrimidine nucleotides.	LW
	Topic 6.2. The integration of metabolism. Principles of hormonal regulation of basic metabolic processes.	LW
	Topic 6.3. 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.	LW

* - 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 equipment and technology support requirements

Type of academic activities	Classroom equipment	Specialised educational / laboratory equipment, software, and materials for course study (if necessary)
Lecture	Classroom, equipped with a set of specialized furniture; whiteboard; a set of devices includes portable multimedia projector, laptop, projection	Projector NEC V 260X, Motorized Display Master Control 203X203. Laboratory equipment: Centrifuge ОПН-8, КФК-3-01 photoelectric colorimeter,

Type of academic activities	Classroom equipment	Specialised educational / laboratory equipment, software, and materials for course study (if necessary)
	screen, stable wireless Internet connection. (class 329, 330, 334, 336)	<p>Drying cabinet SNOL 67/350, thermoblock ПЭ-4030 36 ГН. d-23*45мм, Spectrophotometer SPECORD M -40, Electrophoretic chamber, 1mm, Analytical balance EP214C, Laboratory washing table 985*610*900.</p> <p>Software: Microsoft Windows, MS Office / Office 365, MS Teams, Chrome (latest stable release), Skype (Microsoft Subscription) Enrollment for Education Solutions 90-07-001-00599-8 *Windows 10 Education Desktop Education ALNG LicSAPk MVL A Faculty EES •Win Pro SP1 x64 7, Лицензия № 1620000996000270, дата выдачи 3.5.2014.</p> <p>CFX Manager Software Office Pro Plus 2016 Desktop Education ALNG LicSAPk MVL A Faculty EES 90-07-012-00604-5 MyTestXPro 11.0 Symantec Endpoint Protection 11.0 BNDL STD LIC ACAD BAND A BASIC 12 MO 90-07-010-00211-7</p>
Lab work	Laboratory of Molecular Biological Research Methods equipped with a set of specialized furniture; (201)	<p>Refrigerator ATLANT XM 6026-031, Freezer Минск-17, electronic scales AR0640 Ohaus Europe, Spectrophotometer Hitachi F-2700, Distiller GTL-200, Терmostat, thermoblock ПЭ-4030 36 ГН. d-23*45мм, Spectrophotometer У-2900, Centrifuge L7-55.</p> <p>Computer HP 280 G2 MT V7 Q81E Intel Pentium Dual-Core G4400</p> <p>Software: (Microsoft Subscription) Enrollment for Education Solutions 90-07-001-00599-8 *Windows 10 Education Desktop Education ALNG LicSAPk MVL A Faculty EES •Win Pro SP1 x64 7, CFX Manager Software Office Pro Plus 2016 Desktop Education ALNG LicSAPk MVL A Faculty EES 90-07-012-00604-5 Symantec Endpoint Protection 11.0 BNDL STD LIC ACAD BAND A BASIC 12 MO 90-07-010-00211-7</p>
Self-studies	Classroom, equipped with a set of specialized furniture; whiteboard; a set of devices	Computers HP 15-ac070ur 15,6'' Intel Pentium 5,

Type of academic activities	Classroom equipment	Specialised educational / laboratory equipment, software, and materials for course study (if necessary)
	includes portable multimedia projector, laptop, projection screen, stable wireless Internet connection. (classroom 203)	Refrigerator Бирюса-6, freez Минск-17, Drying cabinet SNOL 67/350, termoblock ПЭ-4030 36 ГН. d-23*45мм, Spectrofotometre Specord М -40, Electrophoretic chamber, 1mm, Analytical balance EP214С. Software: Microsoft (ОС, MS Office/ Office 365, Teams)

* The premises for students' self-studies are subject to **MANDATORY** mention

7. RESOURCES RECOMMENDED FOR COURSE STUDY

Main readings:

1. Baynes J.W., Dominiczac M.H. Medical Biochemistry. - Fifth Edition; - London: Elsevier, 2019. - 682 p.
2. Biochemistry with exercises and tasks: textbook / editors by A. I. Glukhov, V. V. Garin. - Moscow: GEOTAR-Media, 2020. - 296 p. : ill. - Книга на английском языке. - ISBN 978-5-9704-5317-9.
https://lib.rudn.ru:443/MegaPro/UserEntry?Action=Link_FindDoc&id=497894&db=0
3. Berezov T.T.
Biochemistry / T.T. Berezov, B.F. Korovkin ; Transl. from the Russian by V.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. Biochemistry with exercises and tasks : textbook / editors by A. I. Glukhov, V. V. Garin. - Электронные текстовые данные. - Moscow : GEOTAR-Media, 2020. - 296 p. : ill. - Книга на английском языке. - ISBN 978-5-9704-5317-9.
5. Biochemistry 8th ed./ J. M. Berg, J. L. Tymoczko, G. J. Gatto, Jr. L. Stryer. - W. H. Freeman and Company, 2015.
6. 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.
7. Principles of Medical Biochemistry 2nd ed./ Gerhard Meisenberg, William H. Simmons. - Mosby Elsevier, 2006.

Internet sources

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

RUDN Electronic Library System (RUDN ELS) <http://lib.rudn.ru/MegaPro/Web>

- EL "University Library Online" <http://www.biblioclub.ru>
- EL "Yurayt" <http://www.biblio-online.ru>
- EL "Student Consultant" www.studentlibrary.ru
- EL "Lan" <http://e.lanbook.com/>
- EL "Trinity Bridge"

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/>
- NCBI: <https://p.360pubmed.com/pubmed/>
- Bulletin of the RUDN: access mode from the territory of the RUDN and remotely <http://journals.rudn.ru/>
- Scientific Library Elibrary.ru : access by IP addresses of the RUDN at: <http://www.elibrary.ru/defaultx.asp>
- ScienceDirect (ESD), "FreedomCollection", "Cell Press" ID "Elsevier". There is remote access to the database, access by the IP addresses of the RUDN (or remotely by an individual login and password).
- Google Academy (English Google Scholar) is a free search engine for full texts of scientific publications of all formats and disciplines. Indexes the full texts of scientific publications. Access mode: <https://scholar.google.ru/>
- Scopus is a scientometric database of the publishing house of the publishing house "Elsevier". Access to the platform is carried out by the IP addresses of the RUDN or remotely. <http://www.scopus.com/>
- Web of Science. Access to the platform is carried out by the IP addresses of the RUDN or remotely. <http://login.webofknowledge.com/>

*Training toolkit for self- studies to master the course *:*

1. The set of lectures on the course "Biochemistry"
2. The laboratory workshop (if any) on the course "Biochemistry"
3. The guidelines for writing a course paper / project (if any) on the course "Biochemistry".
4.

* The training toolkit for self- studies to master the course is placed on the course page in the university telecommunication training and information system under the set procedure.

8. ASSESSMENT TOOLKIT AND GRADING SYSTEM* FOR EVALUATION OF STUDENTS' COMPETENCES LEVEL UPON COURSE COMPLETION

The assessment toolkit and the grading system* to evaluate the competences formation level (UC-1.1; UC-1.2; UC-6.1; UC-6.2; GPC-1.1; GPC-1.2; GPC-5.1; GPC-5.2; GPC-5.3; GPC-10.1) upon the course study completion are specified in the Appendix to the course syllabus.

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

DEVELOPERS:

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