Federal State Autonomous Educational Institution of Higher Education

PEOPLES' FRIENDSHIP UNIVERSITY OF RUSSIA
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 ofhigher education:

General Medicine
(higher education programme profile/specialisation title)

2022-2023

1. COURSE GOAL(s)

The goal of the course «**Biochemistry**» is to equip students with the systematic 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: **General Competences - GC-1.1; GC-1.2;**

General Professional Competences - GPC-1.1; GPC-1.2; GPC-5.1; GPC-5.2; GPC-5.3; GPC-10.1.

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

Competence code	**Competence descriptor**	**Competence formation indicators** (within this course)
GC-1.	Able to carry out a critical analysis of problem situations based on a systematic approach, develop an action strategy	GC-1.1; analyzes scientific and technical literature and normative documentation of medical organizations.
		GC-1.2; critically assesses the reliability of sources of information, works with conflicting information from different sources.
GC-6.	Able to determine and implement the priorities of their own activities and ways to improve it based on self-assessment	GC-6.1. Evaluates own resources and their limits (personal, situational, temporary), uses them optimally for the successful completion of the assigned task.
		GC-6.2. Analyzes the results obtained in the course of his professional activities, carries out self-control and self-analysis of the process and results of professional activities, evaluates them critically, draws objective conclusions on his work, and correctly defends his point of view.
GPC-1	Able to implement moral and legal norms, ethical and deontological principles in professional activities	GPC-1.1 Be able to comply with moral and legal standards in professional activities
		GPC-1.2 Be able to express professional information in the process of intercultural interaction, observing the principles of ethics and deontology
GPC-2	Able to carry out and monitor the effectiveness of measures for prevention, the formation of a healthy lifestyle and	GPC-2.3 Be able to prepare an oral presentation or printed text that promotes a healthy lifestyle and increases the literacy of the population in matters of disease prevention.

	sanitary and hygienic education of the population	
GPC-5.	Able to assess morphofunctional, physiological conditions and pathological processes in the human body to solve professional problems	GPC-5.1 Own the algorithm of clinical, laboratory and functional diagnostics in solving professional problems
		GPC-5.2 Be able to evaluate the results of clinical, laboratory and functional diagnostics in solving professional problems.
		GPC-5.3 To be able to determine the morphofunctional, physiological states and pathological processes of the human body
GPC -10	Able to solve standard tasks of professional activity using information, bibliographic resources, biomedical terminology, information and communication technologies, taking into account the basic requirements of information security	GPC-10.1 Be able to use modern information and communication tools and technologies in professional activities

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*
GC-1	Able to carry out a critical analysis of problem situations based on a systematic approach, develop an action strategy	Anatomy Physics Chemistry Biology	Topographic anatomy and operative surgery Pathophysiology, clinical pathophysiology Hygiene Propaedeutics of internal diseases Public health and healthcare, health economics Neurology, medical genetics, neurosurgery
GC - 6	Able to determine and implement the priorities of their own activities and	Physics Biology	

	ways to improve it based on self-assessment	Bioorganic chemistry	
GPC-1	Able to implement moral and legal norms, ethical and deontological principles in professional activities	Biology Anatomy Jurisprudence	Propaedeutics internal medicine general surgery
GPC-2	Able to conduct and monitor the effectiveness of preventive measures, the formation of a healthy lifestyle and sanitary and hygienic education of the population	Biology	Hygiene outpatient therapy
GPC-5	Able to assess morphofunctional, physiological conditions and pathological processes in the human body to solve professional problems	Biology Histology, embryology, cytology Anatomy	Topographic anatomy and operative surgery; Pathophysiology, clinical pathophysiology Propaedeutics of internal diseases; General surgery; Urology; Traumatology and orthopedics; Obstetrics and gynecology; Otorhinolaryngology
GPC - 10	Able to solve standard tasks of professional activity using information, bibliographic resources, biomedical terminology, information and communication technologies, taking into account the basic requirements of information security	Mathematics Medical Informatics	Pharmacology Radiation diagnostics general surgery Faculty Surgery Occupational diseases

* 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 "Biochemistry" is _____ credits (_____ 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 (LC)		17	17	-		
Lab work (LW)		140	68	72		
Seminars (workshops/tutorials) (S)						
Self-studies		50	41	18		
Evaluation and assessment (exam/passing/failing grade)		45	18	18		
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.	**Topic 1.1.** Introduction to biochemistry. Amino acids. Proteins: structure, properties, functions. Enzymes. Nucleic acids Protein purification methods. Folding and intracellular degradation of proteins. The concept of proteomics. Complex proteins: hemoglobin, immunoglobulins	LC, LW
	Topic 1.2. Nucleic acids. The concept of genomics. Matrix biosynthesis: replication, transcription, translation	LC, LW
	Topic 1.3. Lipids: structure, functions. Cell membranes. Principles of signal transmission. The structure of hormones	LC, LW
	Topic 1.4. Carbohydrates: structure, functions, classification, properties, isomerism. The concept of glycobiology, protein glycosylation	LC, LW
Module 2 Enzymology and signal transduction principles	**Topic 2.1.** Enzymes. Cofactors. main coenzymes. Isoenzymes. Enzymatic kinetics	LC, LW
	Topic 2.2. Mechanisms of regulation of enzyme activity. Enzyme inhibitors Principles of regulation of metabolism. The use of enzymes in medicine	LC, LW
	Topic 2.3. Principles of signal transmission. Classification of hormones by chemical structure. The concept of secondary intermediaries. messenger systems. Regulation of gene expression	LC, LW

Course module title	Course module contents (topics)	Academic activities types
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. Oxidative stress. 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 glycogen metabolism. Glycogenoses. Regulation of carbohydrate metabolism. Disorders of carbohydrate metabolism in diabetes mellitus and metabolic syndrome	LC, LW
Module 4 Lipid metabolism.	**Topic 4.1.** Digestion, absorption and transport of lipids. Bile acids. Dyslipidemia. Synthesis of HFA and oxidation of HFA. Relationship with energy metabolism.	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 Nitrogen metabolism. Metabolism of complex proteins	**Topic 5.1.** Common pathways of amino acid metabolism. Ways to neutralize ammonia in the body.	LW
	Topic 5.2. Common pathways of amino acid metabolism: transamination, decarboxylation. deamination of amino acids. Ways to neutralize ammonia in the body. Exchange of individual amino acids. Amino acid metabolism disorders	LW
	Topic 5.3. Synthesis and degradation of heme. Synthesis and breakdown of nucleotides	LW
Module 6 Metabolic integration. Clinical biochemistry.	**Topic 6.1.** Metabolic integration. Principles of hormonal regulation of basic metabolic processes. Hierarchy of hormones	LW
	Topic 6.2. Features of the metabolism of individual organs and systems. Metabolic changes during fasting. The role of vitamins and microelements in metabolic processes	LW
	Topic 6.3. Biochemical analyzes of blood and urine in normal and pathological conditions. Matrix biosyntheses: cellular synthesis of DNA, RNA and protein	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)
Lab work	Classroom, equipped with a set of specialized furniture; whiteboard; a set of devices includes portable multimedia projector, laptop, projection screen, stable wireless Internet connection. (class 329, 330, 334, 336)	Projector NEC V 260X, Motorized Display Master Control 203X203. Laboratory equipment: Centrifuge ОПН-8, КФК-3-01 photoelectric colorimeter, 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. 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. 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
Lab work	Laboratory of Molecular Biological Research Methods equipped with a set of specialized furniture; (201)	Refrigerator ATLANT XM 6026-031, Freezer Минск-17, electronic scales AR0640 Ohaus Europe, Spectrophotometer Hitachi F-2700, Distiller GTL-200, Termostat, termoblock ПЭ-4030 36 гн. d-23*45мм, Spectrophotometer У-2900, Centrifuge L7-55. Computer HP 280 G2 MT V7 Q81E Intel Pentium Dual-Core G4400

Type of academic activities	Classroom equipment	Specialised educational / laboratory equipment, software, and materials for course study (if necessary)
		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
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. (аудитория 203)	Computers HP 15-ac070ur 15,6'' Intel Pentium 5, Refrigerator Бирюса-6, freez Минск-17, Drying cabinet SNOL 67/350, termoblock ПЭ-4030 36 гн. d-23*45мм, Spectrofotometre Specord M -40, Electrophoretic chamber, 1mm, Analytical balance EP214C. Software: Microsoft (OC, 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.
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:

***Printed publications*:**

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.
8. Biochemistry 8th ed./ J. M. Berg, J. L. Tymoczko, G. J. Gatto, Jr. L. Stryer. - W. H. Freeman and Company, 2015.

Internet-(based) sources

1. Electronic libraries with access for RUDN students:

   - -Electronic library network of RUDN – ELN RUDN http://lib.rudn.ru/MegaPro/Web
   - - ELN «University Library online» http://www.biblioclub.ru
   - - ELN Urait http://www.biblio-online.ru
   - - ELN «Student Advisor» www.studentlibrary.ru
   - - ELN «Lan» http://e.lanbook.com/

2. Databases and search engines:

   - electronic fund of legal and regulatory and technical documentation http://docs.cntd.ru/
   - search system Yandex https://www.yandex.ru/
   - search system Google https://www.google.ru/
   - abstract database SCOPUS http://www.elsevierscience.ru/products/scopus/ 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 (GC-1.1; GC-1.2; 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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