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**Federal State Autonomous Educational Institution of Higher Education  
PEOPLES' FRIENDSHIP UNIVERSITY OF RUSSIA  
RUDN University  
Institute of Medicine**

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

## **COURSE SYLLABUS**

Medical Enzymology

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course title

**Recommended by the Didactic Council for the Education Field of:**

31.05.01 General Medicine

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field of studies / speciality code and title

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

General Medicine

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higher education programme profile/specialisation title

2022-2023

## 1. COURSE GOAL(s)

The goal of the course “Medical Enzymology” is to equip students with the systemic knowledge of the molecular mechanisms of functioning of biological systems; to ensure the development of a theoretical basis for the further study of biomedical and clinical disciplines.

## 2. REQUIREMENTS FOR LEARNING OUTCOMES

Mastering the course (module) “Medical Enzymology” is aimed at the development of the following competences /competences in part: Universal Competences- (GC)-1, General Professional Competences- (GPC)-1, General Professional Competences- (GPC)-5.

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

<b>Competence code</b>	<b>Competence descriptor</b>	<b>Competence formation indicators (within this course)</b>
GC-1	Is able to search, critically analyze and synthesize information, apply a systematic approach to solving tasks	GC-1.1 Analyzes the task, highlighting its basic components
GPC-1	Able to apply knowledge of biological diversity and use methods of observation, identification, classification, reproduction and cultivation of living objects to solve professional tasks	GPC-1.1 Uses the theoretical foundations of microbiology and virology to study living objects, their identification and cultivation.
GPC-5	Able to assess morpho-functional, physiological states and pathological processes in the human body to solve professional problems	GPC-5.1. Using knowledge of the principles of modern biotechnology, genetic engineering techniques, the basics of nanobiotechnology and molecular modeling, evaluates and predicts the prospects of the objects of his professional activity for biotechnological and biomedical industries.
		GPC-5.2. Owns methods of assessing the biological safety of products of biotechnological and biomedical industries.

## 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 search, critically analyze and synthesize information, apply a systematic approach to solving tasks	Biochemistry Anatomy Hygiene	Topographic anatomy and operative surgery
GPC-1	Able to apply knowledge of biological diversity and use methods of observation, identification, classification, reproduction and cultivation of living objects to solve professional tasks	Biochemistry Anatomy	Forensic medicine
GPC-5	Able to assess morphofunctional, physiological states and pathological processes in the human body to solve professional problems	Anatomy Biology	General pathology and pathologic physiology; Pathologic anatomy General and clinical pharmacology; Forensic medicine; Neurology; Obstetrics and gynecology

#### 4. COURSE WORKLOAD AND ACADEMIC ACTIVITIES

The total workload of the course “Medical Enzymology” is 4 credits (144 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	
		6	
Contact academic hours	72	72	
including:			
Lectures (LC)			
Lab work (LW)	72	72	
Seminars (workshops/tutorials) (S)	-	-	
Self-studies	54	54	

Type of academic activities		Total academic hours	Semesters/training modules	
			6	
<i>Evaluation and assessment (exam/passing/failing grade)</i>		18	18	
<b>Course workload</b>	academic hours	<b>144</b>	<b>144</b>	
	credits	<b>4</b>	<b>4</b>	

## 5. COURSE CONTENTS

*Table 5.1. Course contents and academic activities types*

Course module title	Course module contents (topics)	Academic activities types
<b>Module 1</b> The main aspects of the use of enzymes in medicine.	<b>1.1.</b> Medical enzymology. Targets and goals. History of development and success of medical enzymology in Russia Mechanisms of enzymatic catalysis and regulation of enzyme activity	LW
	<b>1.2.</b> Engineering Enzymology	LW
<b>Module 2</b> Enzyme diagnostics	<b>2.1.</b> Enzymes, isoenzymes and their role in the diagnostics of internal organs pathologies.	LW
	<b>2.2.</b> Laboratory tests for determination of enzyme activity in the clinical practice.	LW
<b>Module 3</b> Enzyme pathology.	<b>3.1.</b> Congenital metabolic disorders. General principles of diagnosis and treatment of inborn enzymopathy. The concept of orphan diseases Disorders of ornithine cycle enzymes: clinical and biochemical correlations	LW
	<b>3.2.</b> Inborn disorders of carbohydrate metabolism. Glycogenoses. Disorders of the metabolism of fructose and galactose. Hemolytic anemia (deficiency of glucose-6-phosphate dehydrogenase, pyruvate kinase)	LW
	<b>3.3.</b> Lysosomal accumulation diseases	LW
	<b>3.4.</b> Congenital disorders of amino acid metabolism	LW
	<b>3.5.</b> Inborn disorders of the metabolism of steroid compounds and heme breakdown products.	LW
<b>Module 4</b> Enzyme therapy	<b>4.1.</b> Enzymes used for replacement therapy in patients with pancreatic insufficiency	LW
	<b>4.2.</b> Thrombolytic enzymes and blood coagulation factors	LW
	<b>4.3</b> Enzymes used in the treatment of cancer	LW
<b>Module 5</b>	<b>5.1.</b> Target enzymes for the treatment of cancer	LW

Course module title	Course module contents (topics)	Academic activities types
Enzymes as targets for therapeutical correction	<b>5.2.</b> Enzymes of Human Immunodeficiency Virus and Hepatitis C Virus as targets for antitumor therapy	LW
	<b>5.3.</b> Enzymes of purine and pyrimidine metabolism as targets for antitumor therapy	LW
	<b>5.6.</b> Target Enzymes for Anti-Inflammatory Drugs	LW
	<b>5.7.</b> Target Enzymes for the Treatment of Cardiovascular Diseases	LW
	<b>5.8.</b> Tyrosine kinases that regulate tumor progression as targets for chemotherapy of malignant tumors.	LW

## 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	A lecture hall for lecture-type classes, equipped with a set of specialised furniture; board (screen) and technical means of multimedia presentations.	
Lab work	A classroom for laboratory work, individual consultations, current and mid-term assessment; equipped with a set of specialised furniture and machinery.	Pestle microbiological homogenizer Vilitex DY89-II, pestles and containers to it for 3, 5, 10, 20 and 50 ml. NANODROP 2000C Thermo Fisher Microspectrophotometer Camera for horizontal electrophoresis Sub-Cell GT, 15x15 cm, combs for 15 and 20 holes (1 piece each), with stops for filling Bio-Rad 1704402 - 2 pieces Camera for vertical electrophoresis Mini-PROTEAN® Tetra Bio-Rad 165800 - 2 pcs

Type of academic activities	Classroom equipment	Specialised educational / laboratory equipment, software, and materials for course study (if necessary)
		<p>PowerPack Basic Power Supply</p> <p>Power supply for 4 electrophoretic chambers with output voltage up to 300 V. Bio-Rad 1645050</p> <p>SM - 6M desktop centrifuge with 6M rotor (12 x12ml vials) Elmi</p> <p>Transilluminator TCP-20.MC wavelength 312 and 254 nm, screen size 20 x 20 cm. Vilber Lourmat VL 2161 2017 1</p> <p>Desktop pH Meter Series Starter 5000 Ohaus, Ohaus ST5000, pH meter MettlerToledo</p> <p>Microcentrifuge 5420 Microcentrifuge with rotation speed up to 15060 rpm, with the ability to work with standard test tubes on 0,2/0,5/0,6/1,5 and 2 ml and PCR strips. Epp 5420 000.318, Eppendorf</p> <p>Evolution™ 201/220 UV-Visible Spectrophotometer 840-210600, Thermo Fisher</p> <p>Multimodal reader ClarioStar Omega BMG LABTECH 415-10</p> <p>Thermoshaker TS-100C, BS-010143-AAI, BioSan</p> <p>Liebherr GNP 3056 freezer, Biryusa-6 refrigerator, Minsk-17 Freezer.</p> <p>Laboratory medical centrifuge ProfMT, Refrigerator ATLANT</p>

Type of academic activities	Classroom equipment	Specialised educational / laboratory equipment, software, and materials for course study (if necessary)
		<p>XM 6026-031, Freezer Minsk-17, Electronic scales AR0640 Ohaus Europe, Spectrophotometer Hitachi F-2700, Distiller GTL-200, Thermostat, Thermoblock PE-4030 36 gn. d-23*45mm, Bi-beam Spectrophotometer U-2900, Centrifuge L7-55 HP 280 G2 MT V7 Q81E Intel Pentium Dual-Core G4400 Computer</p> <p>There is an Internet connection</p> <p>Electrophoretic chamber, 1mm, Analytical scales EP214C, Laboratory washing table 985*610*900 .</p> <p>Microcentrifuge Eppendorf Minispin Vortex V-1 plus</p> <p>Flow cytometer MACSQuant Analyzer 10, Fume hood, Thermoblock PE-4030 36 gn. d-23*45mm, Spectrophotometer Specord M -40, HP 280 G2 MT V7 Q81E Intel Pentium Dual-Core G4400 Computer</p>
Seminar	A classroom for conducting seminars, group and individual consultations, current and mid-term assessment; equipped with a set of specialised furniture and technical means for multimedia presentations.	List of specialised equipment, stands, visual posters, etc.
Computer Lab	A classroom for conducting classes, group and individual consultations, current and mid-term assessment, equipped with personal computers (in the amount of	Multimedia projectors and motorized screens

Type of academic activities	Classroom equipment	Specialised educational / laboratory equipment, software, and materials for course study (if necessary)
	____pcs), a board (screen) and technical means of multimedia presentations.	NEC V 260X Projector, Motorized Screen for Master Control Projector 203X203. laboratory equipment: Exhaust hood, CENTRIFUGE OPN-8, KFK-3-01 photoelectrocolorimeter, Electric drying cabinet SNOL 67/350, Thermoblock PE-4030 36 gn. d-23*45mm, Spectrophotometer Specord M -40, Computer HP 280 G2 MT V7 Q81E Intel Pentium Dual-Core G4400
Self-studies	A classroom for independent work of students (can be used for seminars and consultations), equipped with a set of specialised furniture and computers with access to the electronic information and educational environment.	

## 7. RESOURCES RECOMMENDED FOR COURSE STUDY

### *Main readings:*

1. Baynes J. W. Medical Biochemistry. - Third Edition; - London: Elsevier, 2009. - 653 p.
2. Principles of Biochemistry 4nd ed./ Lehninger, A.L., Nelson, D.L., Cox, M.M.- Worth Publishing, 2004.
3. Principles of Medical Biochemistry 2nd ed./ Gerhard Meisenberg, William H. Simmons. - Mosby Elsevier, 2006.
4. Berezov T.T., Chernov N.N. Kuznetsova O.M. Collection of biochemistry tests. – M. Publishing house "Orgservice-2000". --2011. - 60 p
5. Principles of Biochemistry 4nd ed./ Lehninger, A.L., Nelson, D.L., Cox, M.M.- Worth Publishing, 2004.
6. Principles of Medical Biochemistry 2nd ed./ Gerhard Meisenberg, William H. Simmons. - Mosby Elsevier, 2006.



### *Additional readings:*

#### ***Electronic full-text materials:***

1. Diagnostic Enzymology [Электронный ресурс] / Steven Kazmierczak [и др.]. 2014. ISBN 9783110207248 URL: <https://search.ebscohost.com/login.aspx?direct=true&db=e000tww&AN=852685&site=eds-live>.
2. M. Senturk. Enzyme Inhibitors and Activators / M. Senturk [Electronic resource]. – IntechOpen, 2017. - 268p. - ISBN: 9789535130574,9789535130581
3. P. D. Sharma. Lysosomes - Associated Diseases and Methods to Study Their Function / P. D. Sharma. [Electronic resource]. – IntechOpen, 2017. – 174 p. - ISBN: 9789535135081,9789535135074
4. Recent Advances and Future Trends in Fermented and Functional Foods. / Patra, J.K., Shin, H.-S., Paramithiotis, S. Recent Advances and Future Trends in Fermented and Functional Foods. [Electronic resource] - MDPI - Multidisciplinary Digital Publishing Institute, 2022. – 204 p. - ISBN: 9783036541907,9783036541891

#### ***Printed publications:***

1. T.T. Berezov and B.F.Korovkiv. Biochemistry. – M., Mir Publishers. -1992. - 515 p.
2. Berezov T.T., Chernov N.N. Kuznetsova O.M. Collection of biochemistry tests . – M. Publishing house "Orgservice-2000". -2011. - 60s.
3. T.T. Berezov and B.F.Korovkiv. Biochemistry. – M., Mir Publishers. -1992. -515 p.
4. Kuznetsova O.M., Smirnova I.P., Chernov N.N., Neborak E.V., Ivanova-Radkevich V.I., Lobaeva T.A. Practical guide to learning Biochemistry M.: Digitpress 2018.-64p.
5. Kuznetsova O.M., Berezov T.T., Chernov N.N. Laboratory Manual on Biochemistry. Part 1. -M.: DIGITPRESS. - 2017. -58 p.
6. Kuznetsova O.M., Berezov T.T., Chernov N.N. Laboratory Manual on Biochemistry. Part 2. -M.: DIGITPRESS. - 2018. -58 p.

#### ***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](http://www.studentlibrary.ru)
  - ELN «Lan» <http://e.lanbook.com/>
  - ELN BRENDA Enzyme Database (<https://www.brenda-enzymes.org/>)
- 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/>

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

## 1. The set of lectures on the course “Medical Enzymology”

\* 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, GPC-1, GPC-5) 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:

Associate Professor of the  
Department of Biochemistry  
named after academician T.T.  
Berezov

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position, department

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signature

E.V. Neborak

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name and surname

Professor of the Department of  
Biochemistry  
named after academician T.T.  
Berezov

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position, department

---

signature

V.S. Pokrovsky

---

name and surname

### HEAD OF EDUCATIONAL DEPARTMENT:

of Biochemistry  
named after academician T.T.  
Berezov

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position, department

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signature

V.S. Pokrovsky

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name and surname

### HEAD OF HIGHER EDUCATION PROGRAMME:

First Deputy Director of MI  
for Academic Affairs

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position, department

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signature

Iv.V.Radysh

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name and surname