Ministry of Health of the Russian Federation

federal state budgetary educational institution
higher education
"North-Western State Medical University named after I.I. Mechnikov"

Ministry of Health of the Russian Federation

(Federal State Budgetary Educational Institution of Higher Education North-Western State Medical University named after I.I. Mechnikov of the Ministry of Health of Russia)

DISCIPLINE WORK PROGRAM

"Biochemistry"

Specialty: 31.05.01 General Medicine

Specialization: **Organization and provision of primary health care to the adult population in medical organizations**

Implementation language: Russian, English

2021

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The work program of the discipline was discussed at a department meeting
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Head of the department _____ / Gaikovaya L.B./
(signature)

Approved by the Methodological Commission for the specialty 31.05.01 General Medicine
May 11, 2021

Chairman _____ / Bakulin I.G./
(signature)

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May 20, 2021

Chairman _____ / Artyushkin S.A. /
(signature)

Date of update:

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1. The purpose of mastering the discipline

The purpose of mastering the discipline “Biochemistry” is the formation of general professional competencies of the student, aimed at mastering systematized knowledge in the field of biological chemistry; about biochemical processes occurring in the human body, in physiological and pathological conditions. To form among students a systematic approach based on fundamental natural scientific knowledge in the field of general and organ-specific biochemistry, taking into account the focus of specialist training - “General Medicine” on the object, type and area of professional activity.

2. The place of discipline in the structure of the educational program

The discipline "Biochemistry" belongs to the mandatory part of Block 1 "Disciplines (modules)" of the main professional educational program in the specialty 31.05.01 General Medicine (specialty level of education), Focus: Organization and provision of primary health care to the adult population in medical organizations. The discipline is mandatory to study.

3. List of planned learning outcomes in the discipline, correlated with the planned results of mastering the educational program

Code and name of competency	Code and name of the competency achievement indicator
OPK-5. Able to assess morphofunctional, physiological states and pathological processes in the human body to solve professional problems	ID-1 OPK-5.1. Assesses the degree of functional activity and independence of the patient in self-care, movement, communication
	ID-2 OPK-5.2. Determines and interprets the patient’s vital signs during monitoring over time
	ID-3 OPK-5.3. Determines the main indicators of the patient’s physical development and functional state, taking into account the anatomical and physiological characteristics of the patient’s age
OPK-10. Able to understand the operating principles of modern information technologies and use them to solve professional problems.	ID-1 OPK-10.1. Applies modern information technologies, searches for information on the Internet to solve professional problems
	ID-2 OPK-10.2. Maintains confidentiality when working with patient information databases

Competency achievement indicator code	Learning outcomes (assessment indicators)	Evaluation tools
ID-1 OPK-5.1.	**knows** patterns of biochemical processes occurring in a living organism at the molecular and cellular levels	test questions, test tasks, situational tasks
	can Evaluate and justify conclusions based on the results of biochemical studies	
	has the skill conducting studies of basic biochemical parameters in patients	
ID-2 OPK-5.2	**knows** structure and biochemical properties of the main classes of	test questions, test tasks,

	biologically important compounds, the main metabolic pathways of their transformation; the role of cell membranes and their transport systems in metabolism in the body of children and adolescents and gerontological patients	situational tasks
	can explain changes in biochemical processes in various pathological processes	
	has the skill processing and interpretation of laboratory test results to identify pathological processes	
ID-3 OPK-5.3	**knows** metabolic features and changes in biochemical parameters	test questions, test tasks, situational tasks
	can explain changes in the main biochemical parameters of metabolism use laboratory research methods to diagnose diseases	
	has the skill processing and interpretation of changes in the main biochemical parameters of metabolism	
ID-2 OPK-10.1.	**knows** list of major professional databases and information reference systems	test questions, test tasks, situational tasks
	can calculate the necessary coefficients for biochemical research, apply modern information technologies, search for information on the Internet	
	has the skill entering biochemical research data into the research protocol	
ID-2 OPK-10.2.	**knows** rules for preparing biochemical research protocols	test questions, test tasks, situational tasks
	can use safe medical information resources to justify the choice of research methods and interpret changes in basic biochemical parameters	
	has the skill use of secure medical information resources	

4. Scope of discipline and types of academic work

Type of educational work	Labor intensity	Semesters	
		3	4
Contact work between students and teachers	**148**	**84**	**64**
Classroom work:	144	84	60
Lectures (L)	48	28	20
Practical exercises (PP)	96	56	40
Independent work:	**104**	**36**	**68**
during theoretical training	72	36	36
preparation for the exam	32		32
Interim certification: exam, including passing and group consultations			4
Total labor intensity: academic hours	**252**		

credit units	7

5. The content of the discipline, structured by sections (topics) indicating the number of academic hours and types of training sessions

5.1.Content of discipline sections

No.	Name of discipline section	Annotated content of the discipline section	List of competencies formed in the process of mastering the section
1	Structure and properties of proteins, vitamins	Structure of a protein molecule. Physicochemical properties of proteins	OPK-5, OPK-10
2	Enzymology	Structure, properties, mechanisms of action of enzymes. Mechanisms of regulation of enzymatic activity	OPK-5, OPK-10
3	Energy metabolism	Biological oxidation and ATP formation. Metabolomics.	OPK-5, OPK-10
4	Antioxidant systems	Antioxidant system, composition, biological role. PFC.	OPK-5, OPK-10
5	Carbohydrate metabolism	Disorders of carbohydrate metabolism and diabetes mellitus in pediatric practice. Anaerobic glycolysis. Gluconeogenesis. Glycogen metabolism. Aerobic oxidation of carbohydrates. Oxidative decarboxylation of pyruvate. TCA cycle	OPK-5, OPK-10
6	Lipid metabolism	Structure and classification of lipids. Digestion of lipids in the gastrointestinal tract. Features of lipid digestion in children and adolescents. Tissue lipid metabolism. Lipolysis of tissue lipids, -oxidation of fatty acids, synthesis of fatty acids, synthesis of TAG, synthesis of phospholipids. Hormonal and metabolic regulation of these processes. Lipid disordersβ	OPK-5, OPK-10
7	Protein metabolism	Digestion of proteins in the gastrointestinal tract. Tissue metabolism of amino acids. Biochemistry of milk. Possible protein metabolism disorders	OPK-5, OPK-10
8	Nucleotide metabolism	Structure of nucleic acids.	OPK-5, OPK-10
9	Hormonal regulation of metabolism	Hormones and signaling molecules. Types and structure of cellular receptors. The mechanism of action of hormones. Signaling molecules, mechanisms of action. Hormones of the pituitary gland and thyroid gland. Methods for determining hormones.	OPK-5, OPK-10
10	Biochemistry of organs and tissues	Hemostasis. Biochemistry of muscle and connective tissue. Biochemistry of nervous tissue.	OPK-5, OPK-10

5.2.Thematic plan of lectures

No.	Name of discipline section	Lecture topics	Active forms of learning*	Labor intensity (academic hours)
1	Structure and properties of proteins, vitamins	L.1 Structure of a protein molecule	LB	2
2	Structure and properties of proteins, vitamins	L.2 Physicochemical properties of proteins	LB	2
3	Enzymology	L.3 Structure, properties, mechanisms of action of enzymes	LB	2
4	Enzymology	L.4 Mechanisms of regulation of enzymatic activity	LB	2
5	Structure and properties of proteins, vitamins	L.5 Water-soluble vitamins	LB	2
6	Energy metabolism	L.6 Tissue respiration, oxidative phosphorylation	LB	2
7	Carbohydrate metabolism	L.7 Anaerobic glycolysis. Gluconeogenesis. Glycogen metabolism	LB	2
8	Carbohydrate metabolism	L.8 Aerobic oxidation of carbohydrates. Oxidative decarboxylation of pyruvic acid. TCA cycle	LB	2
9	Carbohydrate metabolism	L.9 Regulation of carbohydrate metabolism	LB	2
10	Hormonal regulation of metabolism	L.10 Hormones and signaling molecules. Mechanism of action of hormones	LB	2
11	Antioxidant systems	L.11 Formation of reactive oxygen species. Antioxidant system, composition, biological role	LB	2
12	Lipid metabolism	L.12 Structure and digestion of lipids. β- oxidation of fatty acids	LB	2
13	Lipid metabolism	L.13 Synthesis of fatty acids. Metabolism of cholesterol and ketone bodies	LB	2
14	Lipid metabolism	L.14 Blood plasma lipoproteins	LB	2
15	Structure and properties of proteins, vitamins	L.15 Fat-soluble vitamins, structure, biological role	LB	2
16	Protein metabolism	L.16 Intermediate metabolism of amino acids	LB	2
17	Protein metabolism	L.17 Ammonia neutralization	LB	2
18	Protein metabolism	L.18 Structure of nucleic acids	LB	2
19	Nucleotide metabolism	L.19 Chromoproteins, structure, role in the body	LB	2

No.	Name of discipline section	Lecture topics	Active forms of learning*	Labor intensity (academic hours)
20	Biochemistry of organs and tissues	L.20 Biochemical mechanisms of detoxification of foreign hydrophobic compounds	LB	2
21	Biochemistry of organs and tissues	L.21 Mineral metabolism	LB	2
22	Biochemistry of organs and tissues	L.22 Biochemistry of muscle and connective tissue	LB	2
23	Biochemistry of organs and tissues	L.23 Biochemistry of nervous tissue	LB	2
24	Biochemistry of organs and tissues	L.24 Integration of metabolism	LB	2
			TOTAL:	48

LB lecture-conversation

5.3.Thematic plan for practical classes

№ p/p	Name of discipline section	Topics of practical classes	Active forms of learning	Current control forms	Labor intensity (academic hours)
1.	Enzymology	C.1 Proteomics. Structur organization of protein molecules. Methods for protein quantification.	TD	testing, interview on control questions, solving situational problems	4
2.	Enzymology	C.2 Physico-chemical properties of proteins. Analysis of the protein composition of blood serum. Proteomic analys methods.	TD	testing, interview on contro questions, solving situational problems	4
3.	Enzymology	C.3 Structure and mechanism of action of enzymes. The influence nonspecific factors on enzyme activity.	TD	testing, interview on contro questions, solving situational problems	4
4.	Enzymology	C.4 Activation and inhibition of enzymes.	TD	testing, interview on test questions, solving situational problems	4
5.	Enzymology	PZ.1 Activation and inhibition of enzymes. Methods for determining enzyme activity	GD, AC	testing, interview on control questions, solving situational problems	4
6.	Enzymology	PZ.2 Test: Proteins and Enzymes	AC	testing, interview on control questions, solving	4

				situational problems	
7.	Carbohydrate metabolism	P3.3 Glycolysis. Gluconeogenesis. Metabolism of pyruvic acid	GD, AC	testing, interview on control questions, solving situational problems	4
8.	Carbohydrate metabolism	P3.4 Aerobic oxidation of carbohydrates (tricarboxylic acid cycle). Biological oxidation	GD, AC	testing, interview on control questions, solving situational problems	4
9.	Hormonal regulation of metabolism	P3.5 Signal molecules, mechanisms of action. Hormones of the pituitary gland and thyroid gland. Methods for determining hormones	GD, AC	testing, interview on control questions, solving situational problems	4
10.	Carbohydrate metabolism	PZ.6. Carbohydrate metabolism disorders and diabetes mellitus	GD, AC	testing, interview on control questions, solving situational problems	4
11.	Carbohydrate metabolism	P3.7 Test. Carbohydrate metabolism	AC	testing, interview on control questions, solving situational problems	4
12.	Lipid metabolism	P3.8 Structure and classification of lipids. Digestion of lipids in the gastrointestinal tract.	GD, AC	testing, interview on control questions, solving situational problems	4
13.	Lipid metabolism	P3.9 Tissue lipid metabolism. Lipolysis of tissue lipids, - oxidation of fatty acids, synthesis of fatty acids, synthesis of TAG, synthesis of phospholipids. Hormonal and metabolic regulation of these processesβ	GD, AC	testing, interview on control questions, solving situational problems	4
14.	Lipid metabolism	P3.10 Cholesterol. Structure, properties, biological role. Blood lipoproteins	GD, AC	testing, interview on control questions, solving situational problems	4

15.	Lipid metabolism	P3.11 Lipid metabolism disorders.	GD, AC	testing, interview on control questions, solving situational problems	4
16.	Lipid metabolism	P3.12 Test. Lipid metabolism.	GD, AC	testing, interview on control questions, solving situational problems	4
17.	Protein metabolism	P3.13 Digestion of proteins in the gastrointestinal tract. Tissue metabolism of amino acids.	GD, AC	testing, interview on control questions, solving situational problems	4
18.	Protein metabolism	P3.14 Possible disorders of protein metabolism	GD, AC	testing, interview on control questions, solving situational problems	4
19.	Protein metabolism	P3.15 Test. Protein metabolism, protein synthesis	AC	testing, interview on control questions, solving situational problems	4
20.	Nucleotide metabolism	P3.16 Bilirubin metabolism	GD, AC	testing, interview on control questions, solving situational problems	4
21.	Nucleotide metabolism	P3.17 Assessment of liver function, biochemical diagnosis of liver dysfunction	GD, AC	testing, interview on control questions, solving situational problems	4
22.	Biochemistry of organs and tissues	P3.18 Biochemical mechanisms of detoxification of endogenous and exogenous compounds. Features of drug metabolism in children and adolescents	GD, AC	testing, interview on control questions, solving situational problems	4
23.	Biochemistry of organs and tissues	P3.19 Biochemistry of the kidneys	GD, AC	testing	4
24.	Biochemistry of organs and tissues	P3.20 Integration of metabolism	GD, AC	interview on control questions	4
Total:					96

GD - group discussion

AS - situation analysis

5.4. Thematic plan of seminars - not provided

5.5. Thematic plan of laboratory work - not provided

5.6. Independent work:

No.	Name of discipline section	Types of independent work	Current control forms	Labor intensity (academic hours)
1.	Carbohydrate metabolism	1.Working with lecture material. 2.Working with educational literature 3. Preparing for the exam	testing, interview control questions, solving situational problem	18
2.	Lipid metabolism	1.Working with lecture material. 2.Working with educational literature 3. Preparing for the exam	testing, interview control questions, solving situational problem	18
3.	Protein metabolism	1.Working with lecture material. 2.Working with educational literature 3. Preparing for the exam	testing, interview control questions, solving situational problem	18
4.	Nucleotide metabolism	1.Working with lecture material. 2.Working with educational literature 3. Preparing for the exam	testing, interview control questions, solving situational problem	12
5.	Hormonal regulation of metabolism	1.Working with lecture material. 2.Working with educational literature 3. Preparing for the exam	testing, interview control questions, solving situational problem	18
6.	Biochemistry of organs and tissues	1.Working with lecture material. 2.Working with educational literature 3. Preparing for the exam	testing, interview control questions, solving situational problem	20
			TOTAL:	104

6. Guidelines for students on mastering the discipline

To effectively study sections of biochemistry, you need to independently study the educational and methodological materials posted in the MOODLE system, take tests on all proposed topics, get advice from a teacher, and answer test papers.
To successfully pass the intermediate certification in the form of an exam, you need to study exam questions and situational tasks.

Planning and organizing the time needed to study the discipline
An important condition for successful mastery of the discipline is the creation of a system of proper organization of work that allows you to distribute the educational load evenly in

accordance with the schedule of the educational process. Drawing up a work plan for the semester, month, week, day can be of great help in this. Its presence will allow you to subordinate your free time to study purposes and work more successfully and efficiently. In the evening you should always distribute work for tomorrow.

At the end of each day, it is advisable to summarize the work: carefully check whether everything was completed according to plan, whether there were any deviations, and if there were, for what reason they occurred. It is necessary to exercise self-control, which is a necessary condition for successful study. If something remains undone, you need to find time to complete this part of the work without reducing the volume of the weekly plan. It is recommended to complete all tasks for practical classes, as well as tasks assigned for independent work, immediately after the corresponding topic of the lecture course, which contributes to better assimilation of the material, allows you to promptly identify and eliminate "gaps" in knowledge, systematize previously covered material, and on its basis begin to master new knowledge and skills.

The university education system is based on a rational combination of several types of training sessions (primarily lectures and practical classes), the work of which has a certain specificity.

Preparing for lectures

Introduction to the discipline occurs already at the first lecture, where you are required not only to pay attention, but also to independently prepare notes. When working with lecture notes, it is necessary to take into account the fact that some lectures provide answers to specific questions on the topic, while others only reveal the relationships between phenomena, helping the student understand the deep processes of development of the subject being studied, both in history and at the present time.

Lecture note-taking is a complex type of classroom work that involves intensive mental activity of the teacher. A note is useful when the most essential things are written down and done by the student himself. There is no need to try to write down the entire lecture verbatim. This kind of "note-taking" does more harm than good. It is advisable to first understand the main idea presented by the lecturer and then write it down. It is advisable to record on one page of the sheet or leave fields on which later, when working independently with notes, you can make additional notes and mark unclear places.

It is better to divide the lecture notes into points, observing the red line. This will be greatly facilitated by the lecture plan questions proposed to the teachers. You should pay attention to the accents and conclusions that the lecturer makes, marking the most important points in the lecture material with the remarks "important", "well remember", etc. You can also do this using colorful markers or pens, emphasizing terms and definitions.

It is advisable to develop your own system of abbreviations, abbreviations and symbols. However, when further working with notes, it is better to replace the symbols with ordinary words for quick visual perception of the text.

When working on lecture notes, it is always necessary to use not only the textbook, but also the literature that was additionally recommended by the lecturer. It is this kind of serious, painstaking work with the lecture material that will allow you to deeply master the theoretical material.

Preparation for practical exercises

Careful thinking and study of the plan's issues is based on studying the current material of the lecture, and then studying the required and additional literature recommended for this topic. All new concepts on the topic being studied must be memorized and included in a glossary, which should be kept from the very beginning of the course.

The result of such work should be manifested in the ability to freely answer theoretical questions of the workshop, speak and participate in a collective discussion of issues on the topic being studied, and correctly complete practical assignments and tests.

In the process of preparing for practical classes, it is necessary to pay special attention to independent study of the recommended literature. Despite the completeness of the lecture notes, it is impossible to present all the material in it due to the limit of classroom hours. Therefore, independent work with textbooks, teaching aids, scientific and reference literature, materials from periodicals and the Internet is the most effective method of obtaining additional knowledge, allows you to significantly intensify the process of mastering information, promotes a deeper assimilation of the material being studied, and forms the correct attitude to a specific problem.

Recommendations for working with literature

It is advisable to start working with literature by studying general works on the topic, as well as textbooks and teaching aids. Next, it is recommended to move on to the analysis of monographs and articles that consider individual aspects of the problems studied in the course, as well as official materials and unpublished documents (research papers, dissertations), which may contain the main issues of the problem being studied.

Working with sources should begin with introductory reading, i.e. view the text, highlighting its structural units. During introductory reading, bookmarks mark those pages that require more careful study.

Depending on the results of the introductory reading, a further method of working with the source is selected. If solving the problem requires studying some fragments of the text, then the selective reading method is used. If the book does not have a detailed table of contents, the student should pay attention to the subject and name indexes.

Selected fragments or the entire text (if it is entirely related to the topic) require thoughtful, leisurely reading with "mental elaboration" of the material. Such reading involves highlighting: 1) the main thing in the text; 2) main arguments; 3) conclusions. Particular attention should be paid to whether the thesis follows from the arguments or not.

It is also necessary to analyze which of the author's statements are problematic, hypothetical, and to grasp hidden issues.

It is clear that the ability to work with text in this way does not come immediately. The best way to learn to highlight the main points in a text, to grasp the problematic nature of statements, and to evaluate the author's position is comparative reading, during which you get acquainted with different opinions on the same issue, compare the weight and evidence of the parties' arguments and draw a conclusion about the greatest persuasiveness of a particular position.

If in the literature there are different points of view on a particular issue due to the complexity of past events and legal phenomena, they cannot be rejected without understanding them. If there are discrepancies between the authors, it is necessary to find a rational grain in each of them, which will allow a deeper understanding of the subject of study and a more critical assessment of the issues being studied. Getting acquainted with the special positions of the authors, you need to identify their similar judgments, arguments, conclusions, and then compare them with each other and apply the one that is more convincing.

The next stage of working with literary sources is the creation of notes that record the main theses and arguments. You can make notes on separate sheets of paper, which can then be easily organized into individual topics of the course being studied. Another way is to keep thematic notebooks on one topic. It is advisable to take notes on large specialized works of a monographic nature in separate notebooks. Here it is important to remember that notes are written on one side of the sheet, with margins and sufficient line spacing for corrections and remarks (these rules are observed for ease of editing). If quotations are given in the notes, then an indication of the source (author, title, imprint, page number) must certainly be given.

7. Evaluation materials

Evaluation materials for the discipline for ongoing monitoring of progress and intermediate certification of students include examples of evaluation tools (Appendix A to the work program of the discipline), procedure and assessment criteria.

8. List of educational literature and Internet resources necessary for mastering the discipline

8.1. Educational literature:

1. Biochemistry: textbook for universities / ed. prof. E.S. Severina. M.: GEOTAR-MED, 2011 – 784 p.
2. Biological chemistry: textbook / T. T. Berezov, B. F. Korovkin. - 3rd ed., revised. and additional - M.: Medicine, 1998. - 703, [1] p. c. : ill. - (Educational literature for students of medical universities).
3.Severin S.E., Biological chemistry with exercises and tasks [Electronic resource]: textbook / ed. S.E. Severina. - 3rd ed., stereotypical. - M.: GEOTAR-Media, 2016. - 624 p. - ISBN 978-5-9704-3971-5 - Access mode: http://www.studmedlib.ru/book/ISBN9785970439715.html
4. Biological chemistry: textbook / T. T. Berezov, B. F. Korovkin. - 3rd ed., revised. and additional - M.: Medicine, 1998. - 703, [1] p. c. : ill. - (Textbook for students of medical universities).
5. Severin S.E., Biological chemistry with exercises and tasks [Electronic resource]: textbook / ed. S.E. Severina. - 3rd ed., stereotypical. - M.: GEOTAR-Media, 2016. - 624 p. - ISBN 978-5-9704-3971-5 - Access mode: http://www.studmedlib.ru/book/ISBN9785970439715.html
6. Vavilova T.P., Biological chemistry in questions and answers [Electronic resource]: study guide / T.P. Vavilova, O.L. Evstafieva. - 3rd ed., rev. and additional - M.: GEOTAR-Media, 2016. - 128 p. - ISBN 978-5-9704-3674-5 - Access mode: http://www.studmedlib.ru/book/ISBN9785970436745.html
7. Proteins and enzymes: educational and methodological manual for practical classes in biological chemistry / ed. prof. V.A. Dadali, Assoc. R.N. Pavlova. – St. Petersburg: Publishing house North-Western State Medical University named after I.I. Mechnikov, 2013 – 103 p.
8. Chemistry and metabolism of carbohydrates. Regulation of carbohydrate metabolism. Hormones: educational and methodological manual for practical classes in biological chemistry / ed. prof. V.A. Dadali, Assoc. Zh.V. Antonova, associate professor R.N. Pavlova. – St. Petersburg: Publishing house North-Western State Medical University named after I.I. Mechnikov, 2013 – 75 p.
9. Chemistry and lipid metabolism Protein metabolism: educational and methodological manual for practical, laboratory and lecture classes in biological chemistry for students of the medical faculty of medical universities / ed. V.A. Dadali, Yu.A. Vlasova. – ed. 4th, revised and additional – St. Petersburg: Publishing house North-Western State Medical University named after I.I. Mechnikov, 2020. – 128 p.
10. Tissue biochemistry: educational and methodological manual for practical, laboratory and lecture classes in biochemistry for students of the medical faculty of medical universities - ed. 4th, revised and additional – St. Petersburg: Publishing house North-Western State Medical University named after I.I. Mechnikov, 2020. – 116 p.
11. Essential Biochemistry for Medical Students with Problem-Solving Exercises / ed. by Glukhov A. I., Gubareva A. E. - Moscow: GEOTAR-Media, 2024. - 584 p. - ISBN 978-5-9704-8863-8. - Text: electronic // Electronic Library System "Student Consultant": [website]. - URL : https://www.studentlibrary.ru/book/ISBN9785970488638.html

8.2.Resources of the Internet information and telecommunications network:

Name of Internet resource	Email address of the resource
Cambridge University Press EastView Medicine and healthcare in Russia	https://www.cambridge.org/core https://dlib.eastview.com
MEDLINE Complete EBSCOhost Web	http://web.b.ebscohost.com/ehost/
ScienceDirect - magazines since 2014, books by list	- https://www.sciencedirect.com/
Scopus – the world's largest single abstract database	https://www.scopus.com/search/form.uri?display=basic
Web of Science - abstract and scientometric electronic databases	https://apps.webofknowledge.com/
Database Nano	https://nano.nature.com/
zbMath Database	https://zbmath.org/
Springer Materials Database	https://materials.springer.com
Springer Protocol Database	https://experiments.springernature.com/springer-protocols-losure\
Scientific electronic library eLIBRARY.RU	https://elibrary.ru/project_orgs.asp
NEICON search in archives of scientific journals	http://archive.neicon.ru/xmlui/
Platform Nature	https://www.nature.com/
Platform Springer Link (magazines and books 2005-2017	https://rd.springer.com/

9. List of information technologies used to master the discipline, including a list of software, professional databases and information reference systems

9.1. List of information technologies used in the educational process:

№ p/p	Name of discipline section	Information technology
1.	Structure and properties of proteins, vitamins	posting of educational materials in EIEE FSBEI HE North-Western State Medical University named after I.I. Mechnikov of the Ministry of Health of Russia https://moodle.szgmu.ru/course/view.php?id=116
2.	Enzymology	posting of educational materials in EIEE FSBEI HE North-Western State Medical University named after I.I. Mechnikov of the Ministry of Health of Russia https://moodle.szgmu.ru/course/view.php?id=116
3.	Template-directed biosynthesis	posting of educational materials in EIEE FSBEI HE North-Western State Medical University named after I.I. Mechnikov of the Ministry of Health of Russia https://moodle.szgmu.ru/course/view.php?id=116
4.	Biological membranes	posting of educational materials in EIEE FSBEI HE North-Western State Medical University named after I.I. Mechnikov of the Ministry of Health of Russia https://moodle.szgmu.ru/course/view.php?id=116
5.	Energy metabolism	posting of educational materials in EIEE FSBEI HE North-Western State Medical University named after I.I. Mechnikov of the Ministry of Health of Russia https://moodle.szgmu.ru/course/view.php?id=116
6.	Carbohydrate metabolism	posting of educational materials in EIEE FSBEI HE North-Western State Medical University named after I.I. Mechnikov of the Ministry of Health of Russia https://moodle.szgmu.ru/course/view.php?id=116

7.	Lipid metabolism	posting of educational materials in EIEE FSBEI HE North-Western State Medical University named after I.I. Mechnikov of the Ministry of Health of Russia https://moodle.szgmu.ru/course/view.php?id=116
8.	Protein metabolism	posting of educational materials in EIEE FSBEI HE North-Western State Medical University named after I.I. Mechnikov of the Ministry of Health of Russia https://moodle.szgmu.ru/course/view.php?id=116
9.	Nucleotide metabolism	posting of educational materials in EIEE FSBEI HE North-Western State Medical University named after I.I. Mechnikov of the Ministry of Health of Russia https://moodle.szgmu.ru/course/view.php?id=116
10.	Hormonal regulation of metabolism	posting of educational materials in EIEE FSBEI HE North-Western State Medical University named after I.I. Mechnikov of the Ministry of Health of Russia https://moodle.szgmu.ru/course/view.php?id=116
11.	Biochemistry of organs and tissues	posting of educational materials in EIEE FSBEI HE North-Western State Medical University named after I.I. Mechnikov of the Ministry of Health of Russia https://moodle.szgmu.ru/course/view.php?id=116

9.2. List of software used in the educational process (licensed and freely distributed software, including domestically produced):

No.	Software product name	License validity period	Documents confirming right to use software products
licensed software			
1.	ESET NOD 32	1 year	Government contract № 07/2020
2.	MS Windows 8 MS Windows 8.1 MS Windows 10 MS Windows Server 2012 Datacenter - 2 Proc MS Windows Server 2012 R2 Datacenter - 2 Proc MS Windows Server 2016 Datacenter Core	Unlimited	State contract No. 30/2013-O; Government contract No. 399/2013-OA; Government contract No. 07/2017-EA.
3.	MS Office 2010 MS Office 2013	Unlimited	Government contract No. 30/2013-OA; Government contract No. 399/2013-OA.
4.	Academic LabVIEW Premium Suite (1 User)	Unlimited	Government contract № 02/2015
licensed software of domestic production			
1.	Anti-plagiarism	1 year	Government contract № 2409
2.	“WEBINAR (WEBINAR)” VERSION 3.0	1 year	Contract No. 347/2020-M
3.	"3KL e-learning environment"	1 year	Contract No. 348/2020-M
4.	TrueConf Enterprise	1 year	Contract No. 396/2020-EA
free software			
1.	Google Chrome	Unlimited	Open License Agreement

			GNU GeneralPublicLicense
2.	NVDA	Unlimited	Open License Agreement GNU GeneralPublicLicense
freely distributed software of domestic production			
1.	Moodle	Unlimited	Open License Agreement GNU GeneralPublicLicense

9.3. List of professional databases and information reference systems:

No.	Name software product	License validity period	Documents confirming right to use software products	Mode access for disabled students and persons with limited health capabilities
1.	Consultant Plus	1 year	Agreement No. 655/2020-EA	-
2.	EBS “Student Consultant”	1 year	Contract No. 307/2020-EA	http://www.studmedlib.ru/
3.	EMB “Doctor Consultant”	1 year	Contract No. 281/2020-EA	http://www.rosmedlib.ru/
4.	EBS "Ibooks.ru/ibooks.ru"	1 year	Contract № 06/2020	https://ibooks.ru
5.	EBS “IPRBooks”	1 year	Contract No. 08/2020-ZK	http://www.iprbookshop.ru/special
6.	Electronic library system “Bukap”	1 year	Contract № 05/2020	https://www.books-up.ru/
7.	EBS "Lan Publishing House"	1 year	Contract No. 395/2020-EA	https://e.lanbook.com/

10. Material and technical support of discipline

Classrooms for conducting lecture-type training sessions, group and individual consultations, ongoing monitoring of progress and intermediate certification of students, equipped with equipment and technical means of teaching: St. Petersburg, Piskarevsky Prospekt, 47, lit. F (building 5), lit. P, FSBEI HE North-Western State Medical University named after I.I. Mechnikov of the Ministry of Health of Russia;
Equipment: board (chalk); teacher's table, double student table, student benches;
Technical teaching aids: multimedia projector, teacher’s laptop, system unit, monitor.
Special technical teaching aids: Roger Pen (Roger personal wireless transmitter in the form of a pen), Roger MyLink (Roger Pen system signal receiver) (for students with hearing impairments); IntelliKeys (wired keyboard with Russian Braille with a matte black finish), (St. Petersburg, Piskarevsky Prospekt, 47, lit. R (building 9), room No. 18.19, Federal State Budgetary Educational Institution of Higher Education North-Western State Medical University named after I.I. Mechnikov of the Ministry of Health of Russia).

Classrooms for conducting seminar-type training sessions, group and individual consultations, ongoing monitoring of progress and intermediate certification of students, equipped with equipment and technical teaching aids:
Equipment: laboratory table for physical research, laminar flow hood, thermostat, automatic variable volume dispensers Research (Eppendorf): 0.5-10 µl, 2-20 µl, 20-200 µl, 100-1000 µl; racks for pipettes and microtubes of 0.2 ml, 0.6 ml, 1.5 ml), laboratory refrigerator with chambers +4°C and -20°C, thermostats, centrifuge with a vertical rotor;
Technical teaching aids: multimedia projector, teacher's laptop, system unit, monitor.
Special technical teaching aids: Roger Pen (Roger personal wireless transmitter in the form of a pen), Roger MyLink (Roger Pen system signal receiver) (for students with hearing impairments); IntelliKeys (wired keyboard with Russian Braille with a matte black finish),

(St. Petersburg, Piskarevsky Prospekt, 47, lit. R (building 9), room No. 18.19, Federal State Budgetary Educational Institution of Higher Education North-Western State Medical University named after I.I. Mechnikov of the Ministry of Health of Russia).

Premises for independent work of students, equipped with computer equipment with the ability to connect to the Internet and provided with access to the electronic information and educational environment of the University: auditorium No. 1, pavilion 32, lit. R (building 9), room. No. 18.19 FSBEI HE North-Western State Medical University named after I.I. Mechnikov of the Russian Ministry of Health.

Appendix A

Ministry of Health of the Russian Federation

federal state budgetary educational institution
higher education
"North-Western State Medical University
named after I.I. Mechnikov"
Ministry of Health of the Russian Federation

(Federal State Budgetary Educational Institution of Higher Education North-Western State Medical University named after I.I. Mechnikov of the Ministry of Health of Russia)

EVALUATION MATERIALS

(for ongoing monitoring of progress and intermediate certification of students)

Specialty:	31.05.01 General medicine
Direction:	Organization and provision of primary health care to the adult population in medical organizations
Name of discipline:	Biochemistry

St. Petersburg – 2021

1. List of planned learning outcomes in the discipline

Competency achievement indicator code	Learning outcomes (assessment indicators)	Evaluation tools
ID-1 OPK-5.1.	**knows** patterns of biochemical processes occurring in a living organism at the molecular and cellular levels	test questions, test tasks, situational tasks
	can Evaluate and justify conclusions based on the results of biochemical studies	
	has the skill conducting studies of basic biochemical parameters in patients	
ID-2 OPK-5.2	**knows** structure and biochemical properties of the main classes of biologically important compounds, the main metabolic pathways of their transformation; the role of cell membranes and their transport systems in metabolism in the body of children and adolescents and gerontological patients	test questions, test tasks, situational tasks
	can explain changes in biochemical processes in various pathological processes	
	has the skill processing and interpretation of laboratory test results to identify pathological processes	
ID-3 OPK-5.3	**knows** metabolic features and changes in biochemical parameters	test questions, test tasks, situational tasks
	can explain changes in the main biochemical parameters of metabolism use laboratory research methods to diagnose diseases	
	has the skill processing and interpretation of changes in the main biochemical parameters of metabolism	
ID-2 OPK-10.1.	**knows** list of major professional databases and information reference systems	test questions, test tasks, situational tasks
	can calculate the necessary coefficients for biochemical research, apply modern information technologies, search for information on the Internet	
	has the skill entering biochemical research data into the research protocol	
ID-2 OPK-10.2.	**knows** rules for preparing biochemical research protocols	test questions, test tasks, situational tasks
	can use safe medical information resources to justify the choice of research methods and interpret changes in basic biochemical parameters	
	has the skill use of secure medical information resources	

2. Examples of assessment tools and assessment criteria for ongoing monitoring

2.1. Examples of incoming control

1. Blood plasma lipoproteins. Separation methods. Classification, structure, biological role. Apoproteins, their role. Reverse cholesterol transport. Biological role. Disorders of lipoprotein metabolism.
2. Reactions of synthesis of triglycerides and phospholipids, the biological role of the process. Interconversion of nitrogenous alcohols in the synthesis of phospholipids. Nutritional factors necessary for the complete synthesis of phospholipids in the cells of the body.

Evaluation criteria, grading scale pass/fail

Rating	Description
"passed"	Demonstrates a thorough understanding of the problem. All requirements for the task have been met
"not accepted"	Demonstrates a lack of understanding of the problem. Many requirements for the assignment have not been met. No answer.

2.2. Examples of test tasks:

ID-1 OPK-5.1.
Question title: Question No. 1
A translation inhibitor is:
1) **tetracycline**
2) rifampicin
3) α-amanitin
4) acridine

ID-2 OPK-5.2
Question name: Question No. 2
Reaction of primary neutralization of ammonia:
1) synthesis of ammonium salts
2) glutamine synthesis
3) glutamine decarboxylation
4) creatinine synthesis

ID-3 OPK-5.3
Question name: Question No. 3
1.An amino acid that forms a disulfide bond is:
1)alanine
2)valine
3)methionine
4)cysteine

ID-2 OPK-10.1.
Question name: Question No. 2
Reaction of primary neutralization of ammonia:
1) synthesis of ammonium salts
2) glutamine synthesis
3) glutamine decarboxylation
4) creatinine synthesis

ID-2 OPK-10.2
Question name: Question No. 4 Bond stabilizing the secondary structure of a protein:

1)hydrogen
2)hydrophobic
3)ionic
4)peptide

Question name: Question No. 5 Fibrillar protein is:
1)albumin
2)collagen
3)myoglobin
4)transferrin

Question name: Question No. 6 The allosteric center is formed by the structure:
1)secondary
2)tertiary
3)primary
4)quaternary

Evaluation criteria, test assignment grading scale

Rating		**Description**
"excellent"	5	Completed in full – 90%-100%
"good"	4	Not fully implemented – 80%-89%
"satisfactory"	3	Completed with deviation – 70%-79%
"unsatisfactory"	2	Partially completed – 69% or less correct answers

2.3. Examples of review questions

ID-1 OPK-5.1.
Question title: Question No. 1
Structure, properties and biological role of phospholipids. Write the reactions for the synthesis of glycerophospholipids. Nutritional factors necessary for the complete synthesis of phospholipids in the body.
ID-2 OPK-5.2
Question name: Question No. 2
The relationship between protein and lipid metabolism. Give examples of the reaction of transition from one type of exchange to another.
ID-3 OPK-5.3
Question name: Question No. 3
Gluconeogenesis. Write down the reactions. Relationship with glycolysis and TCA cycle. Biological role. Hormonal regulation of the process.
ID-2 OPK-10.1.
Question name: Question No. 4
The importance of lipid resynthesis in the intestinal wall. Transport of endogenous lipids.
ID-2 OPK-10.2
Question title: Question No. 5
Synthesis of biogenic amines and catecholamines, write the corresponding reactions. Role in the body. Mechanisms of action of catecholamines (adrenaline).
Question title: Question No. 6
Anaerobic glycolysis, its stages, biological role. Write the appropriate reactions.
Question title: Question No. 7
The allosteric center is formed by the structure:
Reactions of synthesis and use of ketone bodies in the body. The mechanism of development of ketoacidosis. Protective mechanisms against ketoacidosis

Evaluation criteria for test questions

Rating		Description
"excellent"	5	Knows all the educational material, understands it perfectly and has thoroughly mastered it. Gives correct, conscious and confident answers to questions (within the program). In oral answers he uses literary correct language and does not make mistakes.
"good"	4	Knows all the required educational material, understands it well and has mastered it firmly. Answers questions (within the program) without difficulty. In oral answers he uses literary language and does not make gross mistakes
"satisfactory"	3	Knows basic educational material. Answers questions (within the limits of the program) with difficulty. In oral answers, he makes mistakes when presenting the material and in constructing his speech.
"unsatisfactory"	2	Does not know most of the educational material, answers, as a rule, only to the teacher's leading questions, hesitantly. Makes frequent and serious mistakes in oral answers

2.4. Examples of situational tasks:

ID-1 OPK-5.1.
Task No. 1
A 3-year-old child has growth retardation, hypotonia, and delayed ossification processes. In the blood, the level of hormones - growth hormone is reduced, IGF1 is reduced.
Questions:
1. What disease does the child have?
2. Explain changes in hormone levels in the blood.
3. The mechanism of action of the growth hormone.
4. What biochemical processes does growth hormone affect in the human body?
5. Explain the child's clinical symptoms.

ID-2 OPK-5.2
Task No. 2
To find out the cause of furunculosis, a glucose tolerance test was performed. The results were obtained: fasting glucose in the blood - 5.4 mmol/l, 1 hour after the glucose load - 10.5 mmol/l, after 2 hours - 6.8 mmol/l, during the test, glucose in the urine - 3.5 g/day.
Questions:
1. Evaluate the test results.
2. Draw your patient's sugar curve and compare it with the normal sugar curve.
3. Types and mechanism of development of glucosuria?
4. What disorders were detected in the patient?
5. Role of the kidneys in regulating blood glucose levels?

ID-3 OPK-5.3
Task No. 3
In a patient with jaundice of the sclera and skin, a significant increase in the indicator enzymes ALT, AST, PMPA (fructose monophosphate aldolase), and an increase in bilirubin levels were found in the blood; alkaline phosphatase and g-glutamyl transpeptidase are within normal limits, protein content is normal.
Questions:

1. What type of liver damage syndrome occurs?
2. What liver functions are impaired?
3. Explain the changes in biochemical parameters of blood serum in this syndrome.
4. The causes of this syndrome.
5. Which bilirubin fraction predominates in the blood?

ID-2 OPK-10.1.

Task No. 4

A 30-year-old woman complains of low temperature, cold intolerance, weakness, enlarged thyroid gland, weight gain, deterioration of memory and concentration. The level of hormones in the blood - T3, T4 are reduced, TSH is increased.

Questions:

1. What disease does the patient have?
2. Explain changes in hormone levels in the blood.
3. What biochemical processes are affected by the hormones T3 and T4 in the human body?
4. What metabolic disorders occur with this disease?
5. Explain the clinical symptoms of the disease.

ID-2 OPK-10.2

Task No. 5

The activities of several enzymes were determined in the blood and distributed according to the degree of deviation from the norm:

a) ALT> AST> GLD> amylase
b) CK>AST> LDH> amylase> GLD
c) amylase >lipase>ALT> AST> GLDH

Questions:

1. What are blood plasma indicator enzymes?
2. Which organs are affected in three cases and why?
3. Explain why the spectra characterizing different diseases have the same composition, but a different sequence of enzymes in the indicated series?
4. The significance of determining the activity of creatine phosphokinase in the blood?
5. Reasons for decreased enzyme activity in the blood

Task No. 6

The patient has stabbing pain behind the chest, shortness of breath, pallor. In the clinic, the patient's blood was taken several times at different times.

Questions:

1. The activity of which enzymes should be determined in the blood to diagnose myocardial infarction?
2. What proteins are determined in the blood to diagnose myocardial infarction?
3. How does the activity of cardiac markers in the blood change?
4. Dynamics of changes in the activity of cardiac markers in the blood.
5. The importance of determining the activity of cardiac markers over time.

Task No. 7

The patient complains of weakness, joint and muscle pain, bleeding and swelling of the gums, loose teeth, anemia in the blood.

Questions:

1. What vitamin deficiency did the patient develop?
2. Biochemical functions of the vitamin.
3. The role of vitamin deficiency in the development of clinical signs in this patient.
4.Daily requirement of this vitamin.
5. Products containing this vitamin.

Rating	**Description**

"excellent"	5	Explanation of the process of solving a situational problem is detailed, consistent, competent, with theoretical justifications, with the necessary schematic images and visual demonstrations, with correct and fluent use of terminology; answers to additional questions are correct and clear
"good"	4	Explanation of the process of solving a situational problem is detailed, but not logical enough, with isolated errors in details, some difficulties in theoretical justification, schematic images and visual demonstrations, answers to additional questions are correct, but not clear enough
"satisfactory"	3	Explanation of the process of solving a situational problem is insufficiently complete, inconsistent, with errors, weak theoretical justification, with significant difficulties and errors in schematic images and visual demonstrations, answers to additional questions are not clear enough, with errors in details
"unsatisfactory"	2	The explanation of the process of solving a situational problem is given incompletely, inconsistently, with gross errors, without theoretical justification, without the ability to provide schematic images and visual demonstrations or with a large number of errors, answers to additional questions are incorrect or missing

3. Current control procedure

Current monitoring of academic performance in the discipline is carried out in the form of: entrance control, testing, control questions and situational tasks

4. Examples of assessment tools and assessment criteria for intermediate certification

4.1. Sample checklist of questions to prepare for the exam:

ID-1 OPK-5.1.
1. Denaturation. Mechanisms of action of denaturing factors. Role in biology and medicine.
ID-2 OPK-5.2
2. Types of enzyme inhibition. Examples of the effect of inhibitors on the activity of dehydrogenases and cholinesterase
ID-3 OPK-5.3
3.Tertiary structure of protein, characteristics of fibrillar and globular proteins
ID-2 OPK-10.1.
4. The structure of enzymes, the role of active and allosteric centers in enzyme activity
5. Write the reactions of glycogen synthesis. Metabolic and hormonal regulation.
ID-2 OPK-10.2.
6. Ways of formation and neutralization of ammonia.
7. The role of phenylalanine and tyrosine in the synthesis of biologically active compounds in different organs.

Evaluation Criteria:

Rating	Description

Rating		Description
"excellent"	5	Knows all the educational material, understands it perfectly and has thoroughly mastered it. Gives correct, conscious and confident answers to questions (within the program). In oral answers he uses literary correct language and does not make mistakes.
"good"	4	Knows all the required educational material, understands it well and has mastered it firmly. Answers questions (within the program) without difficulty. In oral answers he uses literary language and does not make gross mistakes
"satisfactory"	3	Knows basic educational material. Answers questions (within the limits of the program) with difficulty. In oral answers, he makes mistakes when presenting the material and in constructing his speech.
"unsatisfactory"	2	Does not know most of the educational material, answers, as a rule, only to the teacher's leading questions, hesitantly. Makes frequent and serious mistakes in oral answers

4.2. Examples of situational tasks:

ID-1 OPK-5.1.

Task 1. When examining the patient, the following results were obtained: a fasting blood glucose test - 3 mmol/l, during the day after meals - 5.6 mmol/l, a urine test revealed persistent glucosuria.

Questions:

1. What is the normal level of glucose in blood and urine?
2. Types and mechanism of development of glucosuria?
3. What disorders were detected in the patient?
4. Role of the kidneys in regulating blood glucose levels?
5. What additional biochemical tests should be prescribed for this pathology?

ID-2 OPK-5.2

Task 2. During an accident at a chemical production plant, a worker was poisoned by mercury dichloride vapor. During the examination, the following indicators were determined: urea content in the blood - 40 mmol/l, urea content in the urine - 90 mmol/day, ammonium salts in the urine - 20 mmol/day.

Questions:

1. Assess changes in biochemical parameters.
2. Name the possible reasons for changes in biochemical parameters.
3. What other biochemical tests are needed to evaluate the functions of this organ?
4. What type of azotemia occurs in this case?
5. What enzymes are determined to diagnose this pathology?

ID-3 OPK-5.3

Task 3. Phenylpyruvic acid was found in the urine of a newborn child. The content of phenylalanine in the blood is increased.

Questions:

1. What pathology are we talking about?
2. The cause of this pathology?
3. What are the transformations of phenylalanine in the body normally and in this pathology and indicate the metabolic disorders.
4. What clinical picture is characteristic of this disease?
5. Suggest ways of correction.

ID-2 OPK-10.1.

Task 4. The following indicators were determined for a worker who has prolonged contact with dichloroethane: urea content in the blood - 2.2 mmol/l., urea content in the urine - 150 mmol/day, ammonium salts in the urine - 60 mmol/day.

Questions:

1. Evaluate the results of the analysis.
2. What organ pathology is observed in this case?
3. The value of determining urea in blood and urine.
4. The value of determining ammonium salts in urine.
5. What additional biochemical tests need to be determined to assess the functions of this organ?

Task 5. A 53-year-old female patient takes a cortisol analogue and complains of poor health and disproportionate fat deposition. Laboratory testing revealed: ACTH is below normal; blood serum glucose on an empty stomach is 6.8 mmol/l, after 1 hour - 8.5 mmol/l and after 2 hours - 5.5 mmol/l.

Questions:

1. What is the mechanism of action of cortisol on metabolism?
2. What disorders did the patient experience?
3. Explain changes in blood biochemical parameters.
4. Explain the clinical symptoms of the disease.
5. What problems will occur with long-term use of corticosteroids?

ID-2 OPK-10.2.

Task 6. The total protein content of two patients was determined. In patient No. 1, total blood protein is 50 g/l, in patient No. 2 – 95 g/l.

Questions:

1. Normal content of total protein in blood plasma.
2. Reasons for the increase in total protein in blood plasma.
3. Reasons for the decrease in total protein in blood plasma.
4. What protein fractions are determined by electrophoresis of blood serum?

5. Clinical and diagnostic significance of changes in individual protein fractions.

Task 7. During a medical examination, the activity of indicator enzymes and proteins in the blood of workers was determined.

Questions:

1. The significance of determining the activity of indicator enzymes in blood plasma.
2. What indicator enzymes and proteins are determined to diagnose liver dysfunction?
3. What indicator enzymes are determined to diagnose renal and pancreatic dysfunction?
4. What cardiac markers are determined to diagnose cardiac dysfunction?
5. Reasons for the increase and decrease in the activity of indicator enzymes in blood serum.

Evaluation Criteria:

Rating		**Description**
"excellent"	5	Explanation of the process of solving a situational problem is detailed, consistent, competent, with theoretical justifications, with the necessary schematic images and visual demonstrations, with correct and fluent use of terminology; answers to additional questions are correct and clear
"good"	4	Explanation of the process of solving a situational problem is detailed, but not logical enough, with isolated errors in details, some difficulties in theoretical justification, schematic images and visual demonstrations, answers to additional questions are correct, but not clear enough
"satisfactory"	3	Explanation of the process of solving a situational problem is insufficiently complete, inconsistent, with errors, weak theoretical justification, with significant difficulties and errors in schematic images and visual demonstrations, answers to additional questions are not clear enough, with errors in details
"unsatisfactory"	2	The explanation of the process of solving a situational problem is given incompletely, inconsistently, with gross errors, without theoretical justification, without the ability to provide schematic images and visual demonstrations or with a large number of errors, answers to additional questions are incorrect or missing

Final Assessment Criteria

Rating		**Description**
"excellent"	5	The student answered the theoretical question(s) correctly. Demonstrated excellent knowledge of the training material. Completed the practical task(s) correctly. Demonstrated excellent skills and proficiency in applying acquired knowledge and skills when solving problems within the framework of the educational material. Answered all additional questions
"good"	4	The student answered the theoretical question(s) with minor inaccuracies. Demonstrated good knowledge of the training material. Completed the practical task(s) with minor

Rating		Description
		inaccuracies. Demonstrated good skills and proficiency in applying acquired knowledge and skills when solving problems within the framework of the educational material. Answered most additional questions
"satisfactory"	3	The student answered the theoretical question(s) with significant inaccuracies. Demonstrated satisfactory knowledge of the course material. Completed the practical task(s) with significant inaccuracies. Demonstrated satisfactory skills and abilities to apply the acquired knowledge and skills when solving problems within the framework of the educational material. Made many inaccuracies when answering additional questions
"unsatisfactory"	2	The student, when answering the theoretical question(s) and performing the practical task(s), demonstrated an insufficient level of knowledge and skills in solving problems within the educational material. There were many incorrect answers when answering additional questions.

5. Intermediate assessment procedure

Intermediate assessment in the discipline is carried out in the form of an exam. The exam includes: 2 control questions, a situational task