

## Biochemistry

### Syllabus

|                    |                                                                    |
|--------------------|--------------------------------------------------------------------|
| Department         | <b>Morphology and physiology</b>                                   |
| Curriculum         | s310501- ЛечДелоИИ-21-1.plx<br>Specialty 31.05.01 General Medicine |
| Qualification      | <b>General Practitioner</b>                                        |
| Form of education  | <b>Full-time</b>                                                   |
| Total (in credits) | <b>6</b>                                                           |

|                      |     |                            |
|----------------------|-----|----------------------------|
| Total academic hours | 216 | Control:                   |
| including:           |     | Exam, 4 <sup>th</sup> term |
| Classes              | 128 |                            |
| Self-study           | 52  |                            |
| Control hours        | 36  |                            |

### Course outline in terms

| Academic year<br>(Term) | 2 (2.3) |     | 2 (2.4) |     | Total |     |
|-------------------------|---------|-----|---------|-----|-------|-----|
|                         | Cur     | Syl | Cur     | Syl |       |     |
| Weeks                   | 22      |     | 19      |     |       |     |
| Types of classes        | Cur     | Syl | Cur     | Syl | Cur   | Syl |
| Lectures                | 16      | 16  | 16      | 16  | 32    | 32  |
| Practical               | 64      | 64  | 64      | 64  | 128   | 128 |
| Self-study              | 28      | 28  | 37      | 37  | 65    | 65  |
| Control hours           | -       | -   | 27      | 27  | 27    | 27  |
| Total                   | 108     | 108 | 144     | 144 | 252   | 252 |

The Syllabus is compiled by:

*PhD in Medical Sciences (Medicine), Associate Professor Starykh Y.A, teacher Monastery O.A.*

The Syllabus

**Biochemistry**

Developed in accordance with Federal State Educational Standard:

Federal State Educational Standard of higher education in the specialty 31.05.01 General medicine (Order of the Ministry of Education and Science of the Russian Federation on August 12, 2020 No. 988)

Based on the Curriculum:

31.05.01 GENERAL MEDICINE

Specialization: General Medicine

Approved by the Academic Council of Surgut State University, “16” June 2022, Record No.6

The Syllabus was approved by the department

**Morphology and physiology**

Head of Department, Doctor of Medicine, Professor Stolyarov V.V.

| <b>1. COURSE OBJECTIVES</b>                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.1                                                                                                                                                                                                                                                                                                                                             | The <b>aim</b> of the course is to form knowledge about the chemical nature of substances of living organisms, their transformations, the connection of these transformations with the activity of organs and tissues, the basic patterns of metabolic processes and the consequences of their violation; determination of health state and human adaptation at the molecular, cellular and organ levels of the whole body; the ability to analyze results data of biochemical studies and use the gained knowledge to explain the nature of measurable changes in human and to make the diagnosis of the disease.                                                                                                                                                                                                                 |
| 1.2                                                                                                                                                                                                                                                                                                                                             | <b>The objectives:</b><br>– the acquisition of knowledge about the chemical nature of substances that make up living organisms, their transformations, the connection of these transformations with the activity of organs and tissues, the regulation of metabolic processes and the consequences of their violation;<br>– developing students' skills in using laboratory equipment and reagents in compliance with safety regulations, analyzing the data obtained from biochemical research results and using the knowledge gained to explain the nature of changes occurring in the human body and diagnosing the disease;<br>– formation of skills of analytical work with information (educational, scientific, regulatory and reference books and other sources), with information technology, diagnostic research methods |
| <b>2. COURSE OVERVIEW</b>                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Course code (in curriculum)                                                                                                                                                                                                                                                                                                                     | Б1.О.04.07                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>2.1</b>                                                                                                                                                                                                                                                                                                                                      | <b>Assumed background:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|                                                                                                                                                                                                                                                                                                                                                 | Human Anatomy                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|                                                                                                                                                                                                                                                                                                                                                 | Histology, Embryology, Cytology                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|                                                                                                                                                                                                                                                                                                                                                 | Biology                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|                                                                                                                                                                                                                                                                                                                                                 | Chemistry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>2.2</b>                                                                                                                                                                                                                                                                                                                                      | <b>Post-requisite courses and practice:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                                                                                                                                                                                                                                                                                                                                                 | Hygiene                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|                                                                                                                                                                                                                                                                                                                                                 | X-Ray Diagnostics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|                                                                                                                                                                                                                                                                                                                                                 | Pathophysiology                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|                                                                                                                                                                                                                                                                                                                                                 | Clinical Pathophysiology                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|                                                                                                                                                                                                                                                                                                                                                 | Pharmacology                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>3. COMPETENCES UPON COMPLETION OF THE COURSE (MODULE)</b>                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| GPC-5.4 Knows the classification and structure of biochemical compounds, the mechanisms of biochemical processes in the body, their role in maintaining homeostasis, metabolism and pathogenesis of human diseases                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| GPC-5.8 Knows the mechanisms of development of general pathological processes and the pathogenesis of various diseases and pathological conditions of a person; is able to identify the leading factors of pathogenesis in their relationship with a specific disease or pathological condition and substantiate effective pathogenetic therapy |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>By the end of the course students must:</b>                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>3.1</b>                                                                                                                                                                                                                                                                                                                                      | <b>know:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 3.1.1                                                                                                                                                                                                                                                                                                                                           | general patterns of the origin and development of life, human anthropogenesis and ontogenesis;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 3.1.2                                                                                                                                                                                                                                                                                                                                           | safety regulations in biochemical laboratories; the structure and chemical properties of the main classes of biologically important organic compounds;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 3.1.3                                                                                                                                                                                                                                                                                                                                           | structure and biochemical properties of the main classes of biologically important compounds: proteins, nucleic acids, carbohydrates, lipids, vitamins;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 3.1.4                                                                                                                                                                                                                                                                                                                                           | basics of enzymatic catalysis; basics of bioenergy;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 3.1.5                                                                                                                                                                                                                                                                                                                                           | role of cell membranes and their transport systems in the metabolism in the human body; main metabolic pathways; transformation of biologically important compounds: carbohydrates, lipids, amino acids and nucleotides;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 3.1.6                                                                                                                                                                                                                                                                                                                                           | main mechanisms of metabolic transformations; chemical and biological essence of the processes occurring at the molecular and cellular levels in the human body; mechanisms leading to changes in the composition of components of the body biological matrix;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 3.1.7                                                                                                                                                                                                                                                                                                                                           | main instruments and equipment used in the course of biochemical studies of biological material; biochemical methods of laboratory research in ambulatory and inpatient patients; characteristics used in the biochemical diagnosis of biological material; rules for obtaining, transporting and storing samples of biological material; pre-analytical preparation of biological material; accepted units for expressing the results of clinical and biochemical studies; physiological causes of changes in diagnostically significant biochemical parameters.                                                                                                                                                                                                                                                                  |
| <b>3.2</b>                                                                                                                                                                                                                                                                                                                                      | <b>be able to:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 3.2.1                                                                                                                                                                                                                                                                                                                                           | classify chemical compounds, based on their structural formula; use biochemical laboratory equipment; substantiate the necessary set of biochemical parameters for assessing the status of the patient;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 3.2.2                                                                                                                                                                                                                                                                                                                                           | solve case problems;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 3.2.3                                                                                                                                                                                                                                                                                                                                           | find pathognomonic relations between changes in the content of individual components of human biological fluids and diseases of individual organs and systems, search the effectiveness of treatment, make the prognosis of the disease;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

| <b>3.3</b>                                              | <b>have skills of:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                             |                       |                    |                   |                    |                         |
|---------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|-----------------------|--------------------|-------------------|--------------------|-------------------------|
| 3.3.1                                                   | basic conceptual apparatus and principles to selected biochemical methods in the laboratory diagnosis of pathological conditions, monitoring of the treatment and prognosis of the disease; ability to interpret the results of blood biochemical studies and other biological fluids in the algorithm of the diagnostic process, evaluation of the effectiveness of treatment, prognosis of the disease; indicators of the physiological norm of the content of various blood components and other biological fluids. |                             |                       |                    |                   |                    |                         |
| <b>4. STRUCTURE AND CONTENTS OF THE COURSE (MODULE)</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                             |                       |                    |                   |                    |                         |
| <b>Class Code</b>                                       | <b>Topics /Class type</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>Term / Academic year</b> | <b>Academic hours</b> | <b>Competences</b> | <b>Literature</b> | <b>Interactive</b> | <b>Notes</b>            |
|                                                         | <b>Section 1. Protein Chemistry</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                             |                       |                    |                   |                    |                         |
| 1.1                                                     | Amino acid composition of proteins. Peptides /Practice/                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 3                           | 4                     | GPC-5-4, GPC-5.8   | L1.1; L1.2; L2.1  | 0                  | Oral quiz<br>Case study |
| 1.2                                                     | Protein chemistry/Self-study/                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 3                           | 4                     | GPC-5-4, GPC-5.8   | L1.1; L1.2; L2.1  | 0                  | Essays                  |
| 1.3                                                     | Physical and chemical properties of proteins /Practice/                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 3                           | 4                     | GPC-5-4, GPC-5.8   | L1.1; L1.2; L2.1  | 0                  | Oral quiz<br>Case study |
| 1.4                                                     | Final class of the section "Protein Chemistry"/Practice/                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 3                           | 4                     | GPC-5-4, GPC-5.8   | L1.1; L1.2; L2.1  | 0                  | Test                    |
|                                                         | <b>Section 2. Enzymes Coenzymes and prosthetic groups</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                             |                       |                    |                   |                    |                         |
| 2.1                                                     | Structural Organization of Enzymes /Practice/                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 3                           | 4                     | GPC-5-4, GPC-5.8   | L1.1; L1.2; L2.1  | 0                  | Oral quiz<br>Case study |
| 2.2                                                     | Mechanism of enzymes action /Practice/                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 3                           | 4                     | GPC-5-4, GPC-5.8   | L1.1; L1.2; L2.1  | 0                  | Essays                  |
| 2.3                                                     | Regulation of enzyme reactions /Practice/                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 3                           | 4                     | GPC-5-4, GPC-5.8   | L1.1; L1.2; L2.1  | 0                  | Oral quiz<br>Case study |
| 2.4                                                     | Basics of enzyme catalysis /Self-study/                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 3                           | 6                     | GPC-5-4, GPC-5.8   | L1.1; L1.2; L2.1  | 0                  | Essays                  |
| 2.5                                                     | Final class of the section "Enzymes" /Practice/                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 3                           | 4                     | GPC-5-4, GPC-5.8   | L1.1; L1.2; L2.1  | 0                  | Oral quiz<br>Case study |
|                                                         | <b>Section 3. Nucleic acids and matrix synthesis</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                             |                       |                    |                   |                    |                         |
| 3.1                                                     | Nucleic acids and matrix synthesis /Self-study/                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 3                           | 6                     | GPC-5-4, GPC-5.8   | L1.1; L1.2; L2.1  | 0                  | Essays                  |
| 3.2                                                     | DNA structure and function. Polymerase chain reaction /Practice/                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 3                           | 4                     | GPC-5-4, GPC-5.8   | L1.1; L1.2; L2.1  | 0                  | Oral quiz<br>Case study |

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| 3.3                                                               | RNA structure and functions<br>/Practice/                                                                            | 3 | 4 | GPC-5-4,<br>GPC-5.8 | L1.1; L1.2;<br>L2.1 | 0 | Oral quiz<br>Case study |
| 3.4                                                               | Protein synthesis and its regulation<br>/Practice/                                                                   | 3 | 4 | GPC-5-4,<br>GPC-5.8 | L1.1; L1.2;<br>L2.1 | 0 | Essays                  |
| 3.5                                                               | Final class of the section "Nucleic acids and matrix syntheses"<br>/Practice/                                        | 3 | 4 | GPC-5-4,<br>GPC-5.8 | L1.1; L1.2;<br>L2.1 | 0 | Oral quiz<br>Case study |
| <b>Section 4. Biological oxidation</b>                            |                                                                                                                      |   |   |                     |                     |   |                         |
| 4.1                                                               | Introduction to metabolism. General characteristics of biological oxidation.<br>/Lecture/                            | 3 | 2 | GPC-5-4,<br>GPC-5.8 | L1.1; L1.2;<br>L2.1 | 0 |                         |
| 4.2                                                               | General path of catabolism. Cycle of three carboxylic acids<br>/Lecture/                                             | 3 | 2 | GPC-5-4,<br>GPC-5.8 | L1.1; L1.2;<br>L2.1 | 0 |                         |
| 4.3                                                               | Biochemical plan of the of biological membranes structure. Transmembrane substances transfer<br>/Lecture/            | 3 | 2 | GPC-5-4,<br>GPC-5.8 | L1.1; L1.2;<br>L2.1 | 0 |                         |
| 4.4                                                               | Tissue breathing. METZ. Substrate and oxidative phosphorylation. Free oxidation and heat generation<br>/Lecture/     | 3 | 2 | GPC-5-4,<br>GPC-5.8 | L1.1; L1.2;<br>L2.1 | 0 |                         |
| 4.5                                                               | Introduction to metabolism. General path of catabolism. Three carboxylic acid cycle and its regulation<br>/Practice/ | 3 | 4 | GPC-5-4,<br>GPC-5.8 | L1.1; L1.2;<br>L2.1 | 0 | Oral quiz<br>Case study |
| 4.6                                                               | Mitochondrial electron transport chains. Ways of formation of ATP. Biomembranes<br>/Practice/                        | 3 | 4 | GPC-5-4,<br>GPC-5.8 | L1.1; L1.2;<br>L2.1 | 0 | Essays                  |
| 4.7                                                               | Final class of the section "Biological oxidation<br>/Practice/                                                       | 3 | 4 | GPC-5-4,<br>GPC-5.8 | L1.1; L1.2;<br>L2.1 | 0 | Oral quiz<br>Case study |
| 4.8                                                               | Biological oxidation<br>/Self-study/                                                                                 | 3 | 6 | GPC-5-4,<br>GPC-5.8 | L1.1; L1.2;<br>L2.1 | 0 | Essays                  |
| <b>Section 5. Basics of Neuro-Endocrine Metabolism Regulation</b> |                                                                                                                      |   |   |                     |                     |   |                         |
| 5.1                                                               | Basics of the neuro-endocrine regulation of metabolism. Mechanisms of the hormones activity<br>/Practice/            | 3 | 4 | GPC-5-4,<br>GPC-5.8 | L1.1; L1.2;<br>L2.1 | 0 | Oral quiz<br>Case study |
| 5.3                                                               | Final class of the section "Fundamentals of neuro-endocrine regulation of metabolism"<br>/Practice/                  | 3 | 4 | GPC-5-4,<br>GPC-5.8 | L1.1; L1.2;<br>L2.1 | 0 | Oral quiz<br>Case study |
| 5.4                                                               | Basics of neuro-endocrine regulation of metabolism<br>/Self-study/                                                   | 3 | 6 | GPC-5-4,<br>GPC-5.8 | L1.1; L1.2;<br>L2.1 | 0 | Essays                  |
| <b>Section 6. Carbohydrate exchange</b>                           |                                                                                                                      |   |   |                     |                     |   |                         |
| 6.1                                                               | Anaerobic carbohydrate metabolism. Glycogen exchange<br>/Lecture/                                                    | 3 | 2 | GPC-5-4,<br>GPC-5.8 | L1.1; L1.2;<br>L2.1 | 0 |                         |

|                                         |                                                                                        |   |   |                     |                     |   |                         |
|-----------------------------------------|----------------------------------------------------------------------------------------|---|---|---------------------|---------------------|---|-------------------------|
| 6.2                                     | Aerobic carbohydrate conversion. Dichotomic dissociation of carbohydrates<br>/Lecture/ | 3 | 2 | GPC-5-4,<br>GPC-5.8 | L1.1; L1.2;<br>L2.1 | 0 |                         |
| 6.3                                     | Gluconeogenesis, the pentose pathway of carbohydrate conversion.<br>/Lecture/          | 3 | 2 | GPC-5-4,<br>GPC-5.8 | L1.1; L1.2;<br>L2.1 | 0 |                         |
| 6.4                                     | Regulation of carbohydrate metabolism<br>/Lecture/                                     | 3 | 2 | GPC-5-4,<br>GPC-5.8 | L1.1; L1.2;<br>L2.1 | 0 |                         |
| 6.5                                     | Exchange and function of carbohydrates. Glycogen exchange<br>/Practice/                | 4 | 4 | GPC-5-4,<br>GPC-5.8 | L1.1; L1.2;<br>L2.1 | 0 | Oral quiz<br>Case study |
| 6.6                                     | Aerobic carbohydrate metabolism<br>/Practice/                                          | 4 | 4 | GPC-5-4,<br>GPC-5.8 | L1.1; L1.2;<br>L2.1 | 0 | Oral quiz<br>Case study |
| 6.7                                     | Regulation of carbohydrate metabolism<br>/Practice/                                    | 4 | 4 | GPC-5-4,<br>GPC-5.8 | L1.1; L1.2;<br>L2.1 | 0 | Oral quiz<br>Case study |
| 6.8                                     | Final class of the section "Carbohydrate metabolism"<br>/Practice/                     | 4 | 4 | GPC-5-4,<br>GPC-5.8 | L1.1; L1.2;<br>L2.1 | 0 | Oral quiz<br>Case study |
| 6.9                                     | Carbohydrate metabolism<br>/Self-study/                                                | 4 | 9 | GPC-5-4,<br>GPC-5.8 | L1.1; L1.2;<br>L2.1 | 0 | Essays                  |
| <b>Section 7. Lipid metabolism</b>      |                                                                                        |   |   |                     |                     |   |                         |
| 7.1                                     | Blood lipids. Lipoprotein exchange<br>/Lecture/                                        | 4 | 2 | GPC-5-4,<br>GPC-5.8 | L1.1; L1.2;<br>L2.1 | 0 |                         |
| 7.2                                     | Synthesis of fatty acids<br>/Lecture/                                                  | 4 | 1 | GPC-5-4,<br>GPC-5.8 | L1.1; L1.2;<br>L2.1 | 0 |                         |
| 7.3                                     | Fatty acid oxidation<br>/Lecture/                                                      | 4 | 1 | GPC-5-4,<br>GPC-5.8 | L1.1; L1.2;<br>L2.1 | 0 |                         |
| 7.4                                     | Ketogenesis. Cholesterol exchange<br>/Lecture/                                         | 4 | 1 | GPC-5-4,<br>GPC-5.8 | L1.1; L1.2;<br>L2.1 | 0 |                         |
| 7.5                                     | Lipid digestion and absorption. Blood lipids<br>/Practice/                             | 4 | 4 | GPC-5-4,<br>GPC-5.8 | L1.1; L1.2;<br>L2.1 | 0 | Oral quiz<br>Case study |
| 7.6                                     | Fatty acid metabolism<br>/Practice/                                                    | 4 | 4 | GPC-5-4,<br>GPC-5.8 | L1.1; L1.2;<br>L2.1 | 0 | Oral quiz<br>Case study |
| 7.7                                     | Tissue lipid metabolism<br>/Practice/                                                  | 4 | 4 | GPC-5-4,<br>GPC-5.8 | L1.1; L1.2;<br>L2.1 | 0 | Oral quiz<br>Case study |
| 7.8                                     | Final class of the section "Lipid metabolism"<br>/Practice/                            | 4 | 4 | GPC-5-4,<br>GPC-5.8 | L1.1; L1.2;<br>L2.1 | 0 | Oral quiz<br>Case study |
| 7.9                                     | Lipid metabolism<br>/Self-study/                                                       | 4 | 9 | GPC-5-4,<br>GPC-5.8 | L1.1; L1.2;<br>L2.1 | 0 | Essays                  |
| <b>Section 8. Amino acid metabolism</b> |                                                                                        |   |   |                     |                     |   |                         |
| 8.1                                     | General pathway for amino acid catabolism. Amino acids deamination<br>/Lecture/        | 4 | 1 | GPC-5-4,<br>GPC-5.8 | L1.1; L1.2;<br>L2.1 | 0 |                         |
| 8.2                                     | Ammonia exchange. Mechanisms of toxicity<br>/Practice/                                 | 4 | 2 | GPC-5-4,<br>GPC-5.8 | L1.1; L1.2;<br>L2.1 | 0 | Oral quiz<br>Case study |
| 8.3                                     | Sources and consumption of amino acids in the tissues<br>/Practice/                    | 4 | 2 | GPC-5-4,<br>GPC-5.8 | L1.1; L1.2;<br>L2.1 | 0 | Oral quiz<br>Case study |

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|---------------------------------------------------|---------------------------------------------------------------------------------------------------|---|----|---------------------|---------------------|---|-------------------------|
| 8.4                                               | Sources and ways of ammonia neutralization<br>/Practice/                                          | 4 | 4  | GPC-5-4,<br>GPC-5.8 | L1.1; L1.2;<br>L2.1 | 0 | Oral quiz<br>Case study |
| 8.5                                               | Specific amino acid metabolism<br>Pathways<br>/Practice/                                          | 4 | 4  | GPC-5-4,<br>GPC-5.8 | L1.1; L1.2;<br>L2.1 | 0 | Oral quiz<br>Case study |
| 8.6                                               | Final class of the section "Amino acid metabolism"<br>/Practice/                                  | 4 | 4  | GPC-5-4,<br>GPC-5.8 | L1.1; L1.2;<br>L2.1 | 0 | Oral quiz<br>Case study |
| 8.7                                               | Amino acid metabolism<br>/Self-study/                                                             | 4 | 9  | GPC-5-4,<br>GPC-5.8 | L1.1; L1.2;<br>L2.1 | 0 | Essays                  |
| <b>Section 9. Biochemistry of special tissues</b> |                                                                                                   |   |    |                     |                     |   |                         |
| 9.1                                               | Haemoglobin disorder. Exchange of bile pigments<br>/Lecture/                                      | 4 | 2  | GPC-5-4,<br>GPC-5.8 | L1.1; L1.2;<br>L2.1 | 0 |                         |
| 9.2                                               | Detoxifying liver function<br>/Lecture/                                                           | 4 | 2  | GPC-5-4,<br>GPC-5.8 | L1.1; L1.2;<br>L2.1 | 0 |                         |
| 9.3                                               | Vascular platelet haemostasis<br>Coagulative haemostasis.<br>Anticoagulative system<br>/Practice/ | 4 | 2  | GPC-5-4,<br>GPC-5.8 | L1.1; L1.2;<br>L2.1 | 0 | Oral quiz<br>Case study |
| 9.4                                               | Liver biochemistry<br>/Practice/                                                                  | 4 | 4  | GPC-5-4,<br>GPC-5.8 | L1.1; L1.2;<br>L2.1 | 0 | Oral quiz<br>Case study |
| 9.6                                               | Blood biochemistry<br>/Practice/                                                                  | 4 | 4  | GPC-5-4,<br>GPC-5.8 | L1.1; L1.2;<br>L2.1 | 0 | Oral quiz<br>Case study |
| 9.7                                               | Water-electrolyte and salt exchange.<br>Urine<br>/Practice/                                       | 4 | 4  | GPC-5-4,<br>GPC-5.8 | L1.1; L1.2;<br>L2.1 | 0 | Oral quiz<br>Case study |
| 9.8                                               | Biochemistry of the extracellular matrix<br>/Practice/                                            | 4 | 4  | GPC-5-4,<br>GPC-5.8 | L1.1; L1.2;<br>L2.1 | 0 | Oral quiz<br>Case study |
| 9.11                                              | Biochemistry of special tissues<br>/Self-study/                                                   | 4 | 10 | GPC-5-4,<br>GPC-5.8 | L1.1; L1.2;<br>L2.1 | 0 | Essays                  |
| 9.12                                              | /Exam /                                                                                           | 4 | 27 | GPC-5-4,<br>GPC-5.8 | L1.1; L1.2;<br>L2.1 | 0 | Oral quiz<br>Case study |

## 5. ASSESSMENT TOOLS

### 5.1. Tests and tasks

Supplement 1

### 5.2. Topics for written papers

Supplement 1

### 5.3. Fund of assessment tools

Supplement 1

### 5.4. List of assessment tools

Oral quizzes, case studies, tests, essays

## 6. COURSE (MODULE) RESOURCES

### 6.1. Recommended Literature

#### 6.1.1. Core

|      | Authors                        | Title                                                                                                                                                                                                                                                           | Publish, year           | Quantity |
|------|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|----------|
| Л1.1 | Glukhov A.I.,<br>Gubareva A.E. | Essential Biochemistry for Medical Students with Problem-Solving Exercises [Электронный ресурс] / ed. by -. Режим доступа:<br><a href="https://www.studentlibrary.ru/book/ISBN9785970456507.html">https://www.studentlibrary.ru/book/ISBN9785970456507.html</a> | М. : ГЭОТАР-Медиа, 2020 | 1        |

|                                           |                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                      |                         |          |
|-------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|----------|
| Л1.2                                      | Glukhov A.I.,<br>Babchenko E.V.                                                                                                                                                                                                     | Biochemistry of the connective tissue. Biochemistry of mixed saliva [Электронный ресурс] / - М.. Режим доступа:<br><a href="https://www.studentlibrary.ru/book/ISBN9785970449721.html">https://www.studentlibrary.ru/book/ISBN9785970449721.html</a> | ГЭОТАР-Медиа,<br>2019   | 1        |
| <b>6.1.2. Supplementary literature</b>    |                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                      |                         |          |
|                                           | Authors                                                                                                                                                                                                                             | Title                                                                                                                                                                                                                                                | Publish, year           | Quantity |
| Л2.1                                      | by Glukhov A.I.,<br>Garin V.V                                                                                                                                                                                                       | Biochemistry with exercises and tasks [Электронный ресурс] / ed.. -. Режим доступа:<br><a href="https://www.studentlibrary.ru/book/ISBN9785970453179.html">https://www.studentlibrary.ru/book/ISBN9785970453179.html</a>                             | М. : ГЭОТАР-Медиа, 2020 | 1        |
| <b>6.1.3. Course manuals</b>              |                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                      |                         |          |
|                                           | Authors                                                                                                                                                                                                                             | Title                                                                                                                                                                                                                                                | Publish, year           | Quantity |
| <b>6.2. Internet resources</b>            |                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                      |                         |          |
| Э1                                        | <a href="http://biochemistry.ru/Biologicheskajahimija2011/#/1/">http://biochemistry.ru/Biologicheskajahimija2011/#/1/</a>                                                                                                           |                                                                                                                                                                                                                                                      |                         |          |
| Э2                                        | <a href="http://biochemistry.terra-medica.ru">biochemistry.terra-medica.ru</a>                                                                                                                                                      |                                                                                                                                                                                                                                                      |                         |          |
| Э3                                        | <a href="http://edu.sernam.ru/book_b_chem1.php?id=4">edu.sernam.ru/book_b_chem1.php?id=4</a>                                                                                                                                        |                                                                                                                                                                                                                                                      |                         |          |
| Э4                                        | <a href="http://biokhimija.ru/lekcii-po-biohimii.html">http://biokhimija.ru/lekcii-po-biohimii.html</a>                                                                                                                             |                                                                                                                                                                                                                                                      |                         |          |
| Э5                                        | <a href="http://www.biochemistry.ru/biohimija_severina">http://www.biochemistry.ru/biohimija_severina</a>                                                                                                                           |                                                                                                                                                                                                                                                      |                         |          |
| Э6                                        | <a href="http://kpfu.ru/eksu/docs/Biohimiya%20dlya%20studentov%20medicinskih%20specialnostej_83589.pdf?p_random=145">http://kpfu.ru/eksu/docs/Biohimiya%20dlya%20studentov%20medicinskih%20specialnostej_83589.pdf?p_random=145</a> |                                                                                                                                                                                                                                                      |                         |          |
| <b>6.3.1 Software</b>                     |                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                      |                         |          |
| 6.3.1.1                                   | Operational system Microsoft, applied programs pack Microsoft Office                                                                                                                                                                |                                                                                                                                                                                                                                                      |                         |          |
| 6.3.1.2                                   | Internet access (Wi-Fi)                                                                                                                                                                                                             |                                                                                                                                                                                                                                                      |                         |          |
| <b>6.3.2 Information Referral systems</b> |                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                      |                         |          |
| 6.3.2.1                                   | "Garant", "Consultant-plus"                                                                                                                                                                                                         |                                                                                                                                                                                                                                                      |                         |          |

|                          |  |  |  |  |
|--------------------------|--|--|--|--|
| <b>8. Course manuals</b> |  |  |  |  |
| Supplement 2             |  |  |  |  |



**ASSESSMENT TOOLS**

Syllabus Supplement

**Biochemistry**

|                     |                           |
|---------------------|---------------------------|
| Qualification       | Specialist                |
| Specialty           | 31.05.01 General Medicine |
| Form of education   | Full-time                 |
| Designer Department | Morphology and physiology |
| Graduate Department | Internal diseases         |

## Sample tasks and tests

### Stage I: Formative assessment.

#### Module 1 Protein Chemistry

##### 1.1 Points for oral quiz

1. Structure of globular proteins. Secondary structure of globular proteins.

##### 1.2 Case problems and analytical tasks

1. What amino acids belong to the following side chains:

1. - H    2. - CH<sub>3</sub>    3. - CH<sub>2</sub>OH    4. - CH<sub>2</sub>-CH<sub>2</sub>- COOH    5. - CH<sub>2</sub>-COOH    6. - (CH<sub>2</sub>)<sub>4</sub>-NH<sub>2</sub>    7. -CH<sub>2</sub>SH  
8. - CH<sub>2</sub>OHCH<sub>3</sub>

##### 1.3 Test

1. Write the tetrapeptide alanine-glycine-glutamate-lysine and give its full name. What is isoelectric milieu of this peptide?
2. Proteins primary structure.
3. General characteristics of proteins physicochemical properties.
4. General characteristic of histones.

#### Module 2 Enzymes

##### 2.1 Points for oral quiz

1. Functional organisation of enzymes. Active center interrelation with the substrate.
5. Hypoproteinemia - clinical and diagnostic value.

##### 2.2 Case problems and analytical tasks

1. Methanol is a very toxic compound: ingestion of 30 ml of methanol can lead to death. Such toxicity is due to the action of formaldehyde - the product of its transformation. Methanol is oxidized by the action of the liver enzyme - alcohol dehydrogenase. One of the methods of the methanol poisoning treatment is the prescription of inside or intravenous ethanol injections in doses that cause intoxication in a healthy person. Explain the effectiveness of this treatment.

##### 2.3 Points for the final oral quiz

1. Signs of vitamins.
2. Coenzyme forms and functions of vitamins B1, K, B2.
2. Functions of an apoenzyme as a part of enzyme.
4. Describe the international unit of enzyme activity.
5. Description of the oxidoreductases class.
6. Substrate specificity of enzymes, examples.
7. Regulation of enzyme reactions by the amount of substrate.
8. Enzymopathies, causes of development.

#### Module 3 Nucleic acids and matrix syntheses

##### 3.1 Points for oral quiz

1. What of the following substitutions of one amino acid for another due to mutation are consistent with the genetic code? What substitutions cannot be the result of a single base change in mRNA?

Phenylalanine - Leucine

Lysine - Alanine

Alanine - Tyrosine

Phenylalanine - Lysine

##### 3.2 Points for the final oral quiz

1. Write a DNA dinucleotide containing thymine and guanine.
2. General characteristics of protein synthesis problem. Main postulate of molecular biology.
3. RNA biosynthesis.
4. Mechanisms of protein post-translational modification.

#### Module 4 Biological Oxidation

##### 4.1 Points for oral quiz

1. Metabolism and energy relationship.

##### 4.2 Sample of a case study

1. The hypoenergy state may occur due to deficiency of vitamin B1 and A. Explain what catabolism reactions are disturbed by vitamin B1 hypovitaminosis.
- B. Write these reactions, entitle the enzymes and coenzymes participating in these reactions.
- Q. Will B1 hypovitaminosis patients feel better because of an increase of carbohydrates in their diet? Explain the answer.

#### **4.3 Points for the final oral quiz**

1. Anabolism features in humans.
2. Oxidase type of biological oxidation reactions.
3. Regulation of the three carboxylic acid cycle reaction.
4. Characteristics of pyridine dehydrogenases of mitochondrial electronic transport chains.
5. ATP biological role.
6. Organization of mitochondrial electronic transport chains.
7. What is the meaning of the fact that the product of the pyruvate dehydrogenase reaction acetyl-CoA is an inhibitor of the pyruvate dehydrogenase complex?

### **Module 5 Basics of Neuro-Endocrine Metabolism Regulation**

#### **5.1 Points for oral quiz**

1. Membrane-intracellular mechanism of hormones action.

#### **5.2 Sample of a case study**

1. Explain the occurrence of skin hyperpigmentation during primary hypofunction of the adrenal cortex, and its absence in secondary hypofunction.

#### **5.3 Points for the final oral quiz**

1. Scheme of the mechanism of hormones action using cAMP as an intracellular mediator.
2. Describe the changes in direct positive and negative feedbacks in the hypothalamus-pituitary-adrenal cortex when glucocorticoid analogues are implemented.
3. Principles of laboratory diagnosis of endocrine regulation disorders.
4. How will the concentration of thyrotropin change in the blood if there is a primary hypofunction of the thyroid gland?
5. Is it possible for cells of the same type to have receptors for several hormones?

### **Module 6 Carbohydrate Exchange**

#### **6.1 Points for oral quiz**

1. Main carbohydrates of animals and their biological role.

#### **6.2 Sample of a case study**

1. Dyspeptic disorders (vomiting, diarrhea) were observed in a newborn baby after milk feeding. The observed phenomena disappeared when the baby was put on artificial feeding with a glucose containing solution. Lack of activity of one of the enzymes involved in the digestion of carbohydrates is a possible cause of the disease.

a) name this enzyme.

b) write the reaction scheme that it catalyzes.

#### **6.3 Points for the final oral quiz**

1. Vitamin-dependent gluconeogenesis reactions.
2. Evaluate the energy effect of anaerobic fructose-1,6-diphosphate decomposition.
3. Match two statements or indicators (denoted by letters A and B) given in each paragraph of the section, and give the answer in the form: A > B, B > A, A = B.  
A. The number of points of oxidation conjugation with phosphorylation at the level of the substrate during glycolysis.  
B. The number of points of oxidation conjugation with phosphorylation at the level of the substrate during glycogenolysis.
4. Can the fiber consumption affect the absorption of the other components of food, for example, cholesterol?
5. What substrates will be used in gluconeogenesis during fasting?
6. Explain the mechanism of the development of lactic acidosis in alcohol poisoning.
7. Scheme malate-aspartate shuttle mechanism.
8. Gluconeogenesis regulation, the role of vitamins H and PP.
9. Blood glucose, content, diagnostic value.

### **Module 7 Lipid metabolism**

#### **7.1 Points for oral quiz**

1. Bile acids - structure, synthesis, biological role and its regulation.

### **7.2 Sample of a case study**

1. Indicate the cause of steatorrhea, if three acylglycerols and a small amount of fatty acids are detected in the patient's feces, and its color is grayish-white. Is violation of the absorption of fat-soluble vitamins possible with this violation of digestion?

### **7.3 Points for the final oral quiz**

1. Reactions of degradation of tissue glycerophospholipids
2. Which of the following structures corresponds to the position in palmitic acid if only the first of the eight acetyl-CoA molecules used in palmitic acid biosynthesis has contained a radioactive  $^{14}\text{C}$  mark?  
a)  $-\text{OO}^{14}\text{C}^{14}\text{CH}_2(\text{CH}_2)_{12}\text{CH}_2\text{CH}_3$  or b)  $-\text{OOCCH}_2(\text{CH}_2)_{12}^{14}\text{CH}_2^{14}\text{CH}_3$ .
3. Are there any metabolic causes of high cholesterol in patients with diabetes?
4. Why are choline and methionine considered to be the lipotropic factors?
5. Digestion and absorption of lipids. Bile acids - structure, biological role, synthesis and its regulation.
6. Scheme of mobilization of three acylglycerols under the action of adrenaline.

## **Module 8 Amino Acid Exchange**

### **8.1 Points for oral quiz**

1. General scheme of the sources and ways of consumption of amino acids in the tissues  
a) main amino acids.

### **8.2 Sample of a case study**

14. It has been established that the influenza virus may cause a violation of the synthesis of carbamoyl phosphate synthetase I. What concentration of substances in the blood will increase?

- a. Ammonia. b. Alanine
- c. Glutamine. d. Arginine.

### **8.3 Points for the final oral quiz**

1. Reactions of biogenic amines genesis.
2. What digestive enzymes hydrolyze the following bonds in proteins: Alanine-Phenylalanine, Tryptophan-Tyrosine, Valine-Tyrosine, Arginine-Tryptophan, Lysine-Phenylalanine?
3. Can the nutrition of high-grade proteins reduce the need for vitamin PP?
4. Explain why do surgical wounds heal slowly in patients with diabetes mellitus?
5. What way will the increase in ammonia concentration affect the rate of reactions of the threecarboxylic acid cycle?
6. Why is glucose concentration in the blood being remained at an unchanged level during animals long-term feeding with food containing only proteins?
7. General characteristics of amino acid catabolism. Ketogenic and glycogetic amino acids.
8. Carbohydrate and lipid metabolism relationship.

## **Module 9 Biochemistry of specialized tissues**

### **9.1 Points for oral quiz**

1. General characteristics and biological role of plasma proteins. Proteins in the «acute phase». Diagnostic value.

### **9.2 Sample of a case study**

1. What listed substances concentration in the blood will decrease in 1-2 hours after the liver extirpation (complete removal)?

1. Glucose. 2. Ammonia. 3. Amino acids. 4. Urea. 5. Direct bilirubin. 6. VLDL. 7. Creatine. 8. Blood coagulation proteins. 9. Albumin.

### **9.3 Points for the final oral quiz**

1. Biochemical disorders in diabetes mellitus.

**The control work is performed in each of the two terms in the form of writing an essay on the selected topic.**

### **Essay topics**

1. Neuropeptides and their biological role
2. Blood Peptides, formation and biological functions
3. Methodological foundations of Sanger's discovery of the primary structure of bovine insulin. Significance of this discovery for the development of biochemistry
4. Homologous proteins and their possible use in medicine
5. The use of antivitamin in medicine
6. Functional organization of enzymes as a basis for regulating enzyme activity
7. Using the principles and mechanisms of regulation of enzymatic reactions in medicine

8. About DNA and Levin
9. The use of polymerase chain reaction for the diagnosis of infectious, neoplastic and other diseases
10. What is the meaning of meaningless codons?
11. The role of chaperones in protein molecule folding and pathology development
12. Oxygen in a living cell-good and evil
13. Biochemical bases of ion pumps functioning
14. Prostaglandins are a type of signaling molecules. Use in medicine
15. Glycogen diseases
16. The value of the pentose pathway for the functioning of red blood cells
17. Features of fructose and galactose metabolism
18. The role of intestinal-hepatic bile acid circulation in the normalization of cholesterol concentration
19. Mechanism of ketogenesis in diabetes mellitus
20. The role of low-density lipoprotein cholesterol in the development of atherosclerosis
21. Criteria for the biological value of dietary protein
22. Biochemical basis of the mechanism of toxic action of ammonia
23. Biochemical mechanism of gout development, the role of uric acid
24. Acute Phase Proteins, their biological role and diagnostic significance
25. Biochemical mechanism of carcinogenesis
26. Biochemical basis for the development of mucopolysaccharidoses
27. Causes and diagnostic value of determining glucose, protein, blood, bile pigments in the urine.
28. Practical use of liposomes.
29. What did L. Poling for vitaminology?
30. How to treat genetically modified foods
31. Decoding the human genome is the greatest achievement of molecular biology.
32. Use of physical and chemical properties of proteins in medicine

### Stage II: Midterm assessment (exam) 4<sup>th</sup> term

Midterm assessment is carried out in the form of exam. Tasks for the exam include two theoretical questions and one case study.

| Tasks for competence assessment «Knowledge»                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Task type   |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| <p>List of theoretical points for oral quiz</p> <ol style="list-style-type: none"> <li>1. Subject and tasks of biochemistry. The role of biochemistry in the training of a doctor and professional medical practice.</li> </ol> <p>STRUCTURE, PROPERTIES AND FUNCTIONS OF PROTEINS</p> <ol style="list-style-type: none"> <li>2. The amino acid composition of proteins. Formation and nomenclature of peptides. Natural peptides.</li> <li>3. Primary structure of proteins.</li> <li>4. Conformation of globular proteins (secondary, tertiary and quaternary structures).</li> <li>5. Structural organization of fibrillar proteins.</li> <li>6. General characteristics of the physicochemical properties of proteins (hydration, solubility, ionization, denaturation and renaturation).</li> <li>7. Nomenclature and general principles of protein classification. Classification of simple and complex proteins.</li> <li>8. Functions of proteins.</li> </ol> <p>VITAMINS</p> <ol style="list-style-type: none"> <li>9. Vitamins and their biological role. Coenzyme function of vitamins. Provitamins and Antivitamins. The concept of hypo- and hypervitaminosis. General understanding of vitamin therapy and coenzyme therapy.</li> <li>10. The structure, metabolism and function of vitamin A.</li> <li>11. The structure, metabolism and functions of vitamin D.</li> <li>12. Structure, metabolism and functions of vitamin E.</li> <li>13. The structure, metabolism and functions of vitamin K.</li> </ol> | theoretical |

14. Structure, metabolism and functions of vitamin B1.
15. Structure, metabolism and function of vitamin B2.
16. Structure, metabolism and functions of pantothenic acid.
17. Structure, metabolism and functions of vitamin PP.
18. Structure, metabolism and functions of vitamin B6.
19. Structure, metabolism and functions of vitamin B12.
20. Structure, metabolism and functions of vitamin Bc.
21. Structure, metabolism and functions of vitamin C.

#### ENZYMES

22. Structural organization of enzymes: characteristics of one- and two-component enzymes and their components; isozymes; polyenzyme systems.
23. Theoretical foundations and features of enzymatic catalysis.
24. Functional organization of enzymes. Interaction of the active center of the enzyme with the substrate.
25. Substrate specificity and specificity of action. Enzyme nomenclature and classification.
24. General characteristics of the principles and mechanisms of regulation of enzymatic reactions. Regulation of enzyme activity by covalent modification.
25. Kinetics of enzymatic reactions, their dependence on the amount of substrate and enzyme. Effect of temperature and pH on enzyme activity.
26. Isosteric and allosteric regulation of enzyme activity.
27. Medical aspects of enzymology (enzymopathies, enzyme diagnostics, enzyme therapy). Clinical and diagnostic value of determination of  $\beta$ -amylase activity.

#### NUCLEIC ACIDS AND MATRIX SYNTHESSES

28. General characteristics of the problem of protein synthesis. The basic postulate of molecular biology.
29. DNA - nucleotide composition (Chargaff's rules), primary, secondary, tertiary structures.
30. DNA synthesis (replication, repair, reverse transcription).
31. DNA functions. Genome organization.
32. General characteristics of RNA. Types of RNA. RNA synthesis.
33. mRNA - structure, synthesis features, function. Genetic code.
34. tRNA - structure, synthesis features, function.
35. rRNA - structure, synthesis features, function. Ribosomes.
36. Regulation of protein synthesis.
37. Translation and post-translational modification of proteins.
38. Immunoglobulins, structure, synthesis, biological role, diagnostic value.
39. Mutations and molecular pathology.
40. Chain polymerase reaction and its diagnostic value.

#### BIOMEMBRANES AND TRANSMEMBRANE TRANSFER OF SUBSTANCES

41. The structure and function of biomembranes, the role of vitamin E.
42. Transmembrane transport of substances - diffuse and active transport.

#### FUNDAMENTALS OF NEURO-ENDOCRINE REGULATION OF SUBSTANCES

43. The structure and function of hormones.
44. Functional relationship of endocrine glands and the basis of neuro-endocrine regulation of metabolism.
45. Mechanisms of hormone action.
46. Eicosanoids - structure, regulation of synthesis and their role in the regulation of metabolism and physiological functions.
47. Medical aspects of endocrinology. Possible causes of endocrine regulation disorders and diagnosis of the state of the endocrine glands function. Hormone therapy.

INTRODUCTION TO THE EXCHANGE OF SUBSTANCES, GENERAL WAYS OF CATABOLISM.

ELECTRONIC TRANSPORT CHAINS.

48. General characteristics of metabolism and energy. The relationship of metabolism and energy.

49. Common pathway of catabolism. Oxidative decarboxylation of pyruvate. The tricarboxylic acid cycle - regulation, importance, role of vitamins B1, B2, PP and pantothenic acid.

50. General characteristics of biological oxidation. Oxygen consumption routes. Mitochondrial electron transport chains, the role of vitamins B2 and PP.

51. ATP and its biological role, ways of ATP formation. Mechanisms of oxidative and substrate phosphorylation.

52. METC inhibitors. Separation of oxidation and phosphorylation processes. Free oxidation and heat generation.

EXCHANGE OF CARBOHYDRATES

53. The main carbohydrates of animals and their biological role. Digestion and absorption of carbohydrates. General characteristics of the ways of using glucose in the body.

54. Glycogen - structure, biological role, synthesis, mobilization, regulation of glycogen metabolism. Glycogenous diseases.

55. Anaerobic ways of decomposition of carbohydrates - glycolysis, glycogenolysis and their regulation, alcoholic fermentation and alcohol metabolism. The role of vitamins B1, PP and pantothenic acid.

56. Gluconeogenesis, regulation, the role of vitamins H and PP. The relationship between glycolysis and gluconeogenesis (the Corey cycle). Diagnostic value of lactate determination.

57. Aerobic dichotomous decomposition of carbohydrates, the role of vitamins B1, B2, PP and pantothenic acid, malate-aspartate shuttle mechanisms of hydrogen transfer from the cytosol to mitochondria, regulation of the process.

58. Phosphogluconate pathway of conversion of carbohydrates, the role of vitamins B1 and PP, regulation of the process.

59. Neuro-endocrine regulation of carbohydrate metabolism. The role of insulin, glucagon, adrenaline, glucocorticoids, somatostatin and somatotropin.

60. Blood glucose, content, diagnostic value. Glucose tolerance test.

61. Glucosuria, causes of occurrence, diagnostic value. Renal glucose threshold.

62. Metabolic disorders in diabetes mellitus.

63. Lactate and ketoacidosis, causes and consequences.

EXCHANGE OF LIPIDS

64. Digestion and absorption of lipids. Bile acids - structure, biological role, synthesis and regulation.

65. Blood lipids. Lipoproteins - classification, structure, cholesterol transporting lipoproteins. Diagnostic value of determination of  $\beta$ -lipoproteins.

66. Blood lipids. Lipoproteins - classification, structure, lipoproteins, transporting triacylglycerols.

67. Fatty acids - structure, biological role, synthesis and its regulation. The role of vitamins PP, H and pantothenic acid. Diagnostic value.

68. Fatty acids - structure, biological role,  $\beta$ -oxidation and its regulation. The role of vitamins B2, PP and pantothenic acid. Diagnostic value.

69. Ketone bodies - structure, biological role, synthesis and its regulation, utilization. Diagnostic value.

70. Acylglycerols - structure, biological role, synthesis, mobilization from adipose tissue and its regulation. Diagnostic value.

71. Cholesterol - structure, biological role, synthesis and its regulation, the role of PP vitamins and pantothenic acid in cholesterol synthesis. Diagnostic value.

72. Glycerophospholipids - structure, biological role, synthesis and its regulation, decay. Sphingolipids - the concept of structure and biological role. Diagnostic value

#### EXCHANGE OF AMINO ACIDS AND NUCLEOTIDES

73. General characteristics of sources and ways of consumption of amino acids in tissues.

74. Digestion of proteins. Absorption of protein digestion products. Decay of proteins (amino acids) in the intestine.

75. Components, chemical properties and acidity of gastric juice in pathological conditions. Diagnostic value.

76. General characteristics of amino acid catabolism. Ketogenic and glycolytic amino acids.

77. Transamination, the role of vitamin B6. ALT and ASAT and their diagnostic value.

78. Deamination of amino acids. The role of vitamins B6 and PP.

79. Ornithine cycle of urea formation. Synthesis of creatine. Diagnostic value of the determination of urea. The diagnostic value of determining the activity of creatine kinase in the blood serum.

80. Exchange of ammonia. The mechanism of the toxic action of ammonia.

81. Biogenic amines - formation and inactivation. The role of vitamins B6. Histamine, serotonin, catecholamines, GABA and their biological role.

82. Transmethylation and its role in metabolism. The role of folic acid (Bc) and cobalamin (B12) in the exchange of one-carbon fragments.

83. Neuro-endocrine regulation of amino acid metabolism. The role of insulin, growth hormone, glucocorticoids, sex hormones, thyroxine. Hereditary disorders of amino acid metabolism.

84. Synthesis, degradation of purine and pyrimidine nucleotides. Gout. Diagnostic value of determination of uric acid in blood serum.

85. The relationship between carbohydrate and lipid metabolism.

86. The relationship of the metabolism of carbohydrates, amino acids and nucleotides.

#### BIOCHEMISTRY OF BLOOD AND LIVER

87. Hemoglobin - structure, biological role, synthesis and regulation. Diagnostic value.

88. General characteristics and biorol of blood plasma proteins. "Acute phase" proteins. Diagnostic value of determination of total protein in blood serum.

89. Decomposition of hemoglobin, bile pigments.

90. Vascular-platelet hemostasis.

91. Coagulation hemostasis, the role of calcium and vitamin K. The mechanism of blood coagulation

92. The anticoagulant system of the blood. Antithrombin-III and heparin. Fibrinolysis system.

93. Causes of hyperbilirubinemia. Diagnostic value of determination of bilirubin and its fractions in blood serum.

94. Detoxifying function of the liver.

95. The role of the liver in carbohydrate metabolism.

96. The role of the liver in protein metabolism.

97. The role of the liver in lipid metabolism

#### BIOCHEMISTRY OF INTERCELLULAR MATRIX AND WATER-MINERAL EXCHANGE

98. Collagen - structure, biological role, synthesis and decay. The role of vitamin C in collagen synthesis. Elastin.

99. Proteoglycans - structure, biological role, synthesis, decay.

Mucopolysaccharidoses. The structure and function of fibronectin.



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| <p>100. Biological role and general characteristics of the exchange of water, sodium and potassium. Diagnostic value of sodium and potassium determination in blood serum.</p> <p>101. Neuro-endocrine regulation of water-electrolyte metabolism. The role of vasopressin, aldosterone, natriuretic factor.</p> <p>102. Composition and physicochemical properties of urine in normal conditions and in pathological conditions.</p> <p>103. The biological role of calcium and inorganic phosphates. General characteristics of phosphate-calcium metabolism. Diagnostic value of determination of calcium and inorganic phosphates in blood serum.</p> <p>104. Neuroendocrine regulation of phosphate-calcium metabolism. The role of parathyroid hormone, calcium tonin, vitamins of group D.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                         |
| <p><b>Tasks for competence assessment «Abilities»</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <p><b>Task type</b></p> |
| <p>List of test questions:</p> <ol style="list-style-type: none"> <li>1. Why is there a decrease in urine output during stress?</li> <li>2. In inflammation of the renal tissue, an increase in renin secretion occurs. Can this affect the value of blood pressure?</li> <li>3. Why does the absorption of calcium decrease with reduced acidity of gastric juice?</li> <li>4. Why is parathyroid hormone in conditions of vitamin D deficiency unable to maintain the concentration of calcium in the blood?</li> <li>5. What are the consequences of a sharp decrease in the concentration of sodium in the blood, for example, during transfusion of hypotonic fluid?</li> <li>6. What vitamin D metabolite will be needed for kidney disease?</li> <li>7. What case will the blood glucose concentration be higher after taking glucose or fructose?</li> <li>8. Explain the mechanism of development of vitamin D resistant rickets.</li> <li>9. Why does the metabolism of carbohydrates in nerve cells entirely depend on the concentration of glucose in the blood?</li> <li>10. Is it possible to carry out reactions of the ornithine cycle with the block of reactions of the tricarboxylic acid cycle?</li> <li>11. What is the difference in liver and muscle glycogen function?</li> <li>12. If the lactate dehydrogenase reaction is inhibited, how will this affect the rate of glycolysis in general?</li> <li>13. Why are glycolysis enzymes always in excess in cells?</li> <li>14. Can ethanol be converted into glycogen in the body? Explain the answer</li> <li>15. In an experiment, avidin, which is a potent specific inhibitor of biotin enzymes, was added to the liver cell homogenate. Which of the listed transformations will be blocked a) glucose to pyruvate, b) pyruvate to glucose, c) oxaloacetate to glucose, d) pyruvate to acetyl-CoA</li> <li>16. Does fasting tolerance largely depend on fat stores or muscle mass?</li> <li>17. Why is the old custom of giving whiskey or brandy to those who are rescued at sea or in the wilderness to hungry and exhausted people physiologically unjustified?</li> <li>18. What substrates will be used in gluconeogenesis during fasting?</li> <li>19. Which organ's decreased functional activity is indicated by the accumulation of lactate in the blood while aerobic metabolic conditions persist?</li> <li>20. What substrate will be used in gluconeogenesis after intense muscular work?</li> <li>21. Why should a diabetic patient eat something containing carbohydrates after 2 hours after eating and administering insulin?</li> <li>22. An athlete's blood glucose level rises to 6.5 mmol/l and the level of fatty acids to 1.2 mmol/l before a responsible start. What is the reason for the observed changes?</li> <li>23. Explain the mechanism of development of lactic acidosis in case of respiratory poisoning.</li> </ol> | <p>practical</p>        |

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| <p>24. Explain the mechanism of development of lactic acidosis in alcohol poisoning.</p> <p>25. Explain the mechanism of development of lactic acidosis in liver cirrhosis.</p> <p>26. Patients with diabetes mellitus have hypercholesterolemia. Are there metabolic prerequisites for enhanced cholesterol synthesis in such patients?</p> <p>27. Why do people consumed large amounts of carbohydrates show a higher readiness to convert glucose to triacylglycerols?</p> <p>28. What indicator can be used to assess the functional activity of <math>\beta</math>-cells of the pancreas in patients with diabetes mellitus receiving insulin?</p> <p>29. What are three reasons that determine the development of hyperglucosemia in diabetes mellitus?</p> <p>30. Why is gallstone disease more common in women than in men?</p> <p>31. Triacylglycerols are absorbed from the intestine mainly in the form of their digestion products - monoacylglycerols and fatty acids, and in the blood in the composition of chylomicrons monoacylglycerols and fatty acids are practically absent. Explain this phenomenon.</p> <p>32. Is it possible to consider milk as a dietary product that creates functional rest of the liver?</p> <p>33. Which of the following indicators will be changed with the development of hemolytic jaundice? 1. Total bilirubin 2. Direct bilirubin 3. Direct bilirubin 4. Hemoglobin 5. Potassium 6. AlaAT 7. Alkaline phosphatase 8. Gamma-glutamyltranspeptidase 9. Bilirubin of urine 10. Urobilinogen</p> <p>34. Is it possible to disturb the digestion of triacylglycerols under the action of a trypsin inhibitor?</p> <p>35. Is it possible to reduce the rate of synthesis of bile acids from cholesterol with a deficiency of vitamin C?</p> <p>36. What is the importance of impaired synthesis of phosphatidylcholines for the development of fatty liver infiltration?</p> <p>37. Indicate the cause of steatorrhea if fatty acids, monoacylglycerols, diacylglycerols, a small amount of triacylglycerols are found in the patient's feces. Is it possible that the absorption of fat-soluble vitamins is impaired in this digestive disorder?</p> <p>38. Indicate the cause of steatorrhea if triacylglycerols and small amounts of fatty acids are found in the patient's feces. Is it possible that absorption of fat-soluble vitamins is impaired in this digestive disorder??</p> <p>39. Why is it possible to increase the fraction of high density lipoprotein cholesterol when taking unsaturated fatty acids?</p> <p>40. Can you expect to lose weight when consuming carnitine?</p> <p>41. In the experiment, 1-2 hours after extirpation (complete removal) of the liver, what listed substances concentration in the blood will decrease? 1. Glucose. 2. Ammonia 3. Urea. 4. Straight.</p> |  |
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## METHODOLOGICAL GUIDELINES FOR LEARNING OUTCOMES ASSESSMENT

### Stage: Formative assessment

Formative assessment is a regular checking of student academic progress during the academic term. It is performed in various oral and written forms (quizzes, essays, checking of home assignments, compilation of cases, self-study, colloquiums, and testing). During formative assessment, the teacher monitors the level of student's academic progress according to the curriculum identifying lack of knowledge, or misunderstanding.

The tasks of formative assessment are aligned with the Curriculum and Syllabus.

### 1. Guidelines for assessing the oral quiz:

In assessing the teacher takes into account:

- knowledge and understanding of the subject matter;
- activity during the class;
- consistency of presentation;
- argumentation of the answer, the level of independent thinking;
- ability to link theoretical and practical principles with future professional activity.

**Assessment criteria:**

The results are assessed in a four-grading scale: “excellent”, “good”, “satisfactory”, “unsatisfactory”.

| Type of the task | Assessed competences | Assessment criteria                                                                                                                                                                                                                                                                                                                                        | Grade          |
|------------------|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| Oral quiz        | GPC 5.4 GPC 5.8      | <p>The student demonstrates a comprehensive, systematic and in-depth knowledge of the academic material; has learned the required and additional resources.</p> <p>The student demonstrates a consistent and thorough understanding of the required knowledge, concepts, skills of the material learned, and their significance for future profession.</p> | Excellent      |
|                  | GPC 5.4 GPC 5.8      | <p>The student demonstrates a comprehensive knowledge of the academic material; has learned the required and additional resources. The student demonstrates a consistent understanding of the required knowledge, concepts, skills of the material learned, but makes minor errors.</p>                                                                    | Good           |
|                  | GPC 5.4 GPC 5.8      | <p>The student demonstrates basic knowledge necessary for further study; has learned basic recommended literature.</p> <p>The student operates with inaccurate formulating, has difficulties in the independent answers, makes significant mistakes but is able to correct them under the guidance of a teacher.</p>                                       | Satisfactory   |
|                  | GPC 5.4 GPC 5.8      | <p>The student does not know the obligatory minimum or demonstrates gaps in knowledge of the academic material, makes major mistakes or gives completely wrong answers.</p>                                                                                                                                                                                | Unsatisfactory |

**2. Guidelines for a case study assessment:****Assessment criteria:**

The results are assessed in a four-grading scale: “excellent”, “good”, “satisfactory”, “unsatisfactory”.

| Type of the task | Assessed competences | Assessment criteria                                                                                                                                                                                                                           | Grade          |
|------------------|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| Case - study     | GPC 5.4 GPC 5.8      | The student correctly and solves the case-study task, demonstrating deep knowledge. There are no errors in logical reasoning and solution, the problem is solved in a rational way. The right answer is obtained; ways are clearly described. | Excellent      |
|                  |                      | The student correctly solves the case-study task, demonstrating deep knowledge. There are minor errors in logical reasoning and solution, the problem is solved in a rational way. The right answer is obtained, ways are clearly described.  | Good           |
|                  |                      | The student correctly solves the case-study task, demonstrating basic knowledge. There are significant errors in logical reasoning and solution. The student demonstrates difficulties, but still is able to solve a case-study task.         | Satisfactory   |
|                  |                      | The student incorrectly solves the case-study task, makes significant mistakes. The student is not able to solve a case-study.                                                                                                                | Unsatisfactory |

### 3. Guidelines for essay assessment

#### Essay requirements:

- 1) Volume: 1500-300 words,
- 2) Contents structure:
  - Introduction
    - prove the relevance of the chosen topic
    - point out the purpose of the essay
    - give a summary of the main points
  - Body
    - use information obtained from different sources during the research
    - show inaccuracy of the opposite points of view
  - Conclusion
    - express your point of view on the problem under consideration
  - List of references
    - fulfillment of the basic requirements for the abstract, including the correctness of the list of references

The essay assumes usage of several specialized sources (at least 8-10 publications, monographs, the reference media, manuals). Preference is given to the publications in specialized medical journal and monographs including foreign databases.

#### Assessment criteria:

The results are assessed in a four-grading scale: "excellent", "good", "satisfactory", "unsatisfactory".

| Type of the task | Assessed competences | Assessment criteria | Grade |
|------------------|----------------------|---------------------|-------|
|------------------|----------------------|---------------------|-------|

|       |                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |
|-------|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| Essay | GPC 5.4 GPC 5.8 | All requirements for writing and defending an abstract have been met:<br>- the problem is identified and its relevance is justified;<br>- a brief analysis of various points of view on the problem under consideration is made and its own position is logically stated;<br>- conclusions are formulated;<br>- the topic is fully disclosed;<br>- the scope of work has been met;<br>- the requirements for the external design of the abstract are met;<br>- given correct answers to additional questions. | Excellent      |
|       | GPC 5.4 GPC 5.8 | The basic requirements for the abstract and its defense are met, but there are some shortcomings:<br>- inaccuracies in the presentation of the material;<br>- there is no logical consistency in judgments;<br>- the volume of the abstract is not kept;<br>- there are omissions in the design;<br>- incomplete answers were given to additional questions during the defense.                                                                                                                               | Good           |
|       | GPC 5.4 GPC 5.8 | There are significant deviations from the requirements for summarization:<br>- the topic is covered only partially;<br>- factual errors were made in the content of the abstract;<br>- there are errors when answering additional questions;<br>- there is no output during protection.                                                                                                                                                                                                                       | Satisfactory   |
|       | GPC 5.4 GPC 5.8 | The abstract is absolutely not prepared. The topic of the abstract has not been disclosed, there is a significant lack of understanding of the problem.                                                                                                                                                                                                                                                                                                                                                       | Unsatisfactory |

## Stage II: midterm assessment (exam)

### Methodological guidelines for midterm assessment (exam)

#### Examination is held in the oral form and includes several stages:

- oral answer (the card includes two questions);
- situational and analytical task.

#### Requirements for the student:

- 1) regularly attend classes; the absence from classes is not allowed without good reason;
- 2) in case of absence from classes the student has to work out passed classes;
- 3) the student has to hand over written papers on time;

- 4) the student has successfully passed all colloquiums provided by the plan;
- 5) in case the student has been negatively assessed on the colloquium, he/she should try to pass it again;
- 6) during the test week the student has to hand over all the tasks (clinical case).

The students are allowed to take examinations in case of all the tests passed and no academic debts (on the basis of the academic records).

The students are not allowed to take examination:

- with unpassed tests on the discipline;
- with missed classes, debts on the discipline;
- with 5 (five) and more debts for the previous term;
- with one debt for earlier terms for more than a year.

**Recommendations for the examination assessment:**

| Type of the task | Assessed competences | Assessment criteria                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Grade        |
|------------------|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| Oral quiz        | GPC 5.4 GPC 5.8      | The student demonstrates comprehensive, systematic and profound knowledge of the subject, can independently perform the tasks provided by the program; who has a good knowledge of the main literature and familiar with the additional literature recommended by the program; demonstrates creative abilities in understanding, statement and use of material of the studied discipline, faultlessly answers not only questions of the card, but also additional questions within the main program, correctly performs a practical task. | Excellent    |
|                  | GPC 5.4 GPC 5.8      | The student has good knowledge of material of the studied discipline; can successfully perform the tasks provided by the program; has a good knowledge of the main literature recommended by the program; answers all questions of the card, correctly performs a practical task, but makes some mistakes.                                                                                                                                                                                                                                | Good         |
|                  | GPC 5.4 GPC 5.8      | The student demonstrates                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Satisfactory |

|            |                 |                                                                                                                                                                                                                                                                                    |                |
|------------|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
|            |                 | knowledge of material for further study; can cope with the tasks provided by the program; familiar with the main recommended literature; makes mistakes when performing examination tasks, but has necessary knowledge for their elimination under the supervision of the teacher. |                |
|            | GPC 5.4 GPC 5.8 | The student demonstrates poor knowledge of the material, makes significant mistakes in performance of the tasks provided by the program.                                                                                                                                           | Unsatisfactory |
| Case study | GPC 5.4 GPC 5.8 | The student correctly and fully solves the situational task, demonstrating deep knowledge. There are no errors in logical reasoning and solution, the problem is solved in a rational way. The right answer is obtained; ways are clearly described.                               | Excellent      |
|            | GPC 5.4 GPC 5.8 | The student correctly solves the situational task, demonstrating deep knowledge. There are minor errors in logical reasoning and solution, the problem is solved in a rational way. The right answer is obtained, ways are clearly described.                                      | Good           |
|            | GPC 5.4 GPC 5.8 | The student correctly solves the situational task, demonstrating basic knowledge. There are significant errors in logical reasoning and solution. The student demonstrates difficulties, but still is able to solve a case-study task.                                             | Satisfactory   |
|            | GPC 5.4 GPC 5.8 | The student incorrectly solves the situational                                                                                                                                                                                                                                     | Unsatisfactory |

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|  |  | task, makes significant mistakes answering most of the questions of the case-study. The student is not able to solve a case-study. |  |
|--|--|------------------------------------------------------------------------------------------------------------------------------------|--|

**Chart of the examination grade assessment:**

| <b>Tasks</b>                         | <b>Assessed competences</b> | <b>Grade</b>   | <b>Score</b> |
|--------------------------------------|-----------------------------|----------------|--------------|
| Theoretical point № 1<br>(Oral quiz) | GPC 5.4 GPC 5.8             | Excellent      | 5            |
|                                      |                             | Good           | 4            |
|                                      |                             | Satisfactory   | 3            |
|                                      |                             | Unsatisfactory | 2            |
| Theoretical point № 2<br>(Oral quiz) | GPC 5.4 GPC 5.8             | Excellent      | 5            |
|                                      |                             | Good           | 4            |
|                                      |                             | Satisfactory   | 3            |
|                                      |                             | Unsatisfactory | 2            |
| Case study                           | GPC 5.4 GPC 5.8             | Excellent      | 5            |
|                                      |                             | Good           | 4            |
|                                      |                             | Satisfactory   | 3            |
|                                      |                             | Unsatisfactory | 2            |
| Total                                | GPC 5.4 GPC 5.8             | Excellent      | 14-15        |
|                                      |                             | Good           | 12-13        |
|                                      |                             | Satisfactory   | 9-11         |
|                                      |                             | Unsatisfactory | 6-8          |