

**Assessment tools for certification
in the discipline " Medical Biochemistry "
for students of the educational program
specialist degree
in the specialty of training 33.05.01 Pharmacy,
direction (profile) Pharmacy,
form of study full - time
for the 2023-2024 academic year**

№	EXAMINATION QUESTIONS IN MEDICALBIOCHEMISTRY	verifiable universal competencies, general professional competencies, professional competencies
1	The subject and tasks of biological chemistry. Metabolism and energy, complex structural organization, homeostasis and self-reproduction as the most important signs of living matter.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
2	Biochemistry as a molecular level the study of the structural organization, anabolism and catabolism of living matter. The place of biochemistry among other biological disciplines. The importance of biochemistry in the preparing of a doctor and for medicine.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
3	Amino acids included in the composition of proteins, their structure and properties. Peptides. The biological role of amino acids and peptides.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
4	The primary structure of proteins. The peptide bond, its characteristics. The dependence of the protein biological properties on the primary structure. Infringement of the primary structure and function of hemoglobin A (for example, hemoglobin S).	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
5	Conformation of peptide chains in proteins (secondary structure). Types of chemical bonds involved in the formation of the secondary structure. Super secondary structures.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
6	Conformation of peptide chains in proteins (tertiary structure). Types of chemical bonds involved in the formation of the tertiary structure. Domain structure and its role in the functioning of proteins.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
7	The active center of proteins and its specific interaction with the ligand as the basis of the biological function of proteins. Complementarity of interaction proteins with a ligand. The reversibility of binding.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
8	Quaternary structure of proteins. Features of the structure and functioning of oligomeric proteins on the example of hemoglobin. Cooperative changes in the conformation of protomers. The possibility of regulating the biological function of oligomeric proteins by allosteric ligands.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
9	Physico - chemical properties of proteins. Molecular weight, size and shape, solubility, ionization and hydration.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
10	Methods for isolation of individual proteins: methods of precipitation by salting	UC-1.1, GPC-1.1,

	out and organic solvents, gel filtration, electrophoresis, ion exchange and affinity chromatography.	GPC-2.1, PC-4.2, PC-4.3
11	Conformational lability of proteins. Denaturation, agents of denaturation, signs. Protection against denaturation by specialized heat shock proteins (chaperones).	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
12	Principles of protein classifications. Protein classification based on chemical nature and solubility, functional classification of proteins. examples of representatives of individual classes. Conception of proteins families.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
13	Immunoglobulins, classes of immunoglobulins, features of structure and functioning on the example of Ig G.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
14	Enzymes, definition. Chemical nature and properties of enzymes. Enzyme specificity, types. Classification and nomenclature of enzymes, examples.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
15	The structure of enzymes. Catalytic and regulatory centers. Enzyme-substrate complex formation. Lock and key model or Fischer's template theory. Induced fit theory or Koshland's model. Mechanism of enzyme catalysis.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
16	Kinetics of enzymatic reactions. The dependence of the rate of enzymatic reactions on the temperature, pH of the medium, concentration of the enzyme and substrate. The Michaelis-Menten equation, Km.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
17	Enzyme cofactors: metal ions and their role in enzymatic catalysis. Coenzymes as derivatives of vitamins. Coenzyme functions of vitamins B ₆ , PP and B ₂ , the mechanism of action of NAD ⁺ and FAD – dependent dehydrogenases.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
18	Enzyme inhibition: reversible and irreversible; competitive and non-competitive. Enzyme inhibition by drugs.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
19	Allosteric regulation of enzyme activity. The role of allosteric enzymes in cell metabolism. Allosteric activators and inhibitors. Features of the structure and functioning of allosteric enzymes and their localization in metabolic pathways. Regulation of enzyme activity according to the principle of negative feedback. Give examples.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
20	Regulation of the catalytic activity of enzymes by covalent modification by phosphorylation and dephosphorylation (using the example of glycogen synthesis and glycogen degradation enzymes).	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
21	Association and dissociation of protomers by the example of protein kinase A and limited proteolysis during activation of proteolytic enzymes as ways to regulate the catalytic activity of enzymes.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
22	Isoenzymes, their origin, biological significance, examples. Determination of enzymes and the isoenzyme spectrum of blood plasma in order to diagnose diseases.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
23	Enzymopathies are hereditary (phenylketonuria) and acquired (scurvy). The use of enzymes for the treatment of diseases.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2,

		PC-4.3
24	General scheme of synthesis and degradation of pyrimidine nucleotides. Regulation. Orotaciduria.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
25	The general scheme of synthesis and degradation of purine nucleotides. Regulation. Gout.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
26	Synthesis of deoxyribonucleotides. Ribonucleotide reductase complex. Biosynthesis of thymidyl nucleotides, the role of folic acid and folate reductase. Regulation of deoxyribonucleotide synthesis. Antitumor, antiviral and antibacterial drugs as inhibitors of the synthesis of ribonucleotides and deoxyribonucleotides.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
27	The nitrogenous bases included in the structure of nucleic acids (purines and pyrimidines). Nucleotides containing ribose and deoxyribose. Structure. Nomenclature.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
28	The primary structure of nucleic acids. DNA and RNA, similarities and differences in composition, localization in the cell and functions.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
29	The secondary structure of DNA (Watson and Crick model). Bonds that stabilize the secondary structure of DNA. Complementarity. Chargaff's rule. Polarity. Anti-parallelism.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
30	Hybridization of nucleic acids. Denaturation and renaturation of DNA. Hybridization (DNA-DNA, DNA-RNA). Laboratory diagnostic methods based on nucleic acid hybridization. Polymerase chain reaction (PCR).	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
31	Organization of DNA in the cell. Organization of prokaryotic DNA. Organization of eukaryotic DNA structure in the form of chromatin and chromosomes. The role of histones and non-histone proteins in DNA condensation. Covalent modification of histones and its role in the regulation of chromatin structure and activity.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
32	Replication of DNA. Principles of DNA replication. Stages of replication. Initiation. Proteins and enzymes involved in the formation of the replicative fork.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
33	Elongation and termination of replication. Enzymes. Asymmetric synthesis of DNA. Fragments of Okazaki. The role of DNA ligase in the formation of a lagging strand.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
34	Damage and repair of DNA. Types of DNA damages. Repair of DNA. Methods of reparation. Defects in DNA repair and hereditary diseases.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
35	Transcription. Characteristics of the components of the RNA synthesis system. The structure of DNA-dependent RNA polymerase: the role of subunits ($2\alpha\beta\beta'\sigma$). Initiation of the process. Elongation and termination of transcription.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
36	The primary transcript and its processing (post-transcriptional modifications). Ribozymes as an example of the catalytic activity of nucleic	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2,

	acids. Biological role.	PC-4.3
37	Regulation of transcription in prokaryotes. Operon concept, regulation by type of induction and repression (examples).	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
38	Biosynthesis of proteins (translation). The genetic code and its characteristics. Requirement of the components for the protein synthesis: amino acids, aminoacyl-t-RNA synthetases, ribosomes, energy sources, protein factors, enzymes.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
39	Assembly of a polypeptide chain on a ribosome. Formation of the initiator complex. Elongation: formation of a peptide bond (transpeptidation reaction). Translocation. Translocase. Termination.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
40	Post-translational modifications of proteins: partial proteolysis, formation of covalent bonds, attachment of prosthetic groups, covalent modification of amino acid residues (glycosylation, methylation, phosphorylation, acetylation).	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
41	Chaperones and protein folding. Types of chaperones. Protein misfolding and diseases Prion diseases.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
42	Features of synthesis and processing of secreted proteins (for example, collagen and insulin).	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
43	Biochemistry of nutrition. Nutritional importance of carbohydrates, lipids, proteins. The daily requirement of them. Essential components of food.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
44	Nutritional importance of proteins. The biological value of proteins. Nitrogen balance. The usefulness of protein nutrition, daily requirements of proteins, protein deficiency.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
45	Digestion of proteins: gastrointestinal proteases, their activation and specificity, optimum pH and the result of action. Formation and role of hydrochloric acid in the stomach. Protection of cells from the action of proteases.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
46	Absorption of protein digestion products. Transport of amino acids into intestinal cells. Features of amino acid transport in hepatocytes. The γ -glutamyl cycle. Abnormalities of protein digestion and amino acid absorption.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
47	Vitamins. Classification, nomenclature. Provitamins. Hypo-, hyper- and vitamin deficiency, causes of occurrence. Vitamin-dependent and vitamin-resistant conditions.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
48	Minerals of food, macro- and microelements, biological role. Regional pathologies associated with a lack of trace elements.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
49	Biological membranes, structure, functions and general properties: fluidity, transverse asymmetry, selective permeability.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
50	Lipid composition of membranes - phospholipids, glycolipids, cholesterol.	UC-1.1, GPC-1.1,

	Membrane proteins are integral, peripheral and "anchored". The role of individual membrane components in the formation of structure and performance of functions.	GPC-2.1, PC-4.2, PC-4.3
51	Transport across membranes: simple diffusion, passive uniport, symport and antiport, active transport, regulated channels. Membrane receptors, their structure.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
52	Endergonic and exergonic reactions in a living cell. High-energy compounds, the structure of ATP. Dehydrogenation of substrates and hydrogen oxidation as the main energy source for ATP synthesis.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
53	The structure of mitochondria and the structural organization of the respiratory chain. NAD-dependent and flavin-dependent dehydrogenases. Respiratory chain complexes: NADH dehydrogenase, ubiquinol dehydrogenase (cytochrome C reductase), cytochrome C oxidase.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
54	Oxidative phosphorylation, the essence of the process, scheme, substrates, P/O ratio. Transmembrane electrochemical potential as an intermediate form of energy during oxidative phosphorylation. Mitchell's theory. H ⁺ -ATP synthase: role, localization, structure, mechanism of ATP synthesis.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
55	Regulation of the electron transport chain (respiratory control). Uncoupling of tissue respiration and oxidative phosphorylation. Thermoregulatory function of tissue respiration. Brown adipose tissue. Thermogenin, its role.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
56	Formation of reactive oxygen species (singlet oxygen, superoxide radical, hydrogen peroxide, hydroxyl radical, peroxynitrite). The place of formation, reactions, their physiological role.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
57	Harmful effects of free radicals (lipid peroxidation, oxidation of proteins and nucleic acids). Examples of reactions.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
58	Catabolism of the main nutrients in the cell - carbohydrates, fats, amino acids. The concept of specific and general pathways of catabolism. Conversion of pyruvate to acetyl CoA. Reactions of PDH. Regulation of PDH.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
59	Citric acid cycle (Krebs cycle) - the central metabolic pathway. Reactions of citric acid cycle (TCA) and characteristics of enzymes. Regulation of the citric acid cycle.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
60	Citric acid cycle, scheme of process. The connection of the cycle with the electron transport chain. Energetics of citric acid cycle. Amphibolic nature of the citric acid cycle. Anaplerosis or anaplerotic reactions.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
61	The main carbohydrates of animals, structure, biological role. Carbohydrates of food, digestion of carbohydrates. Absorption of digestion products.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
62	Glucose as an important metabolite of carbohydrate metabolism: a general scheme of sources and ways of glucose consumption in the body. Maintaining a constant blood glucose level, the clinical and diagnostic value of determining the amount of blood glucose.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3

63	Aerobic glycolysis. The sequence of reactions before the formation of pyruvate. Physiological significance of aerobic glycolysis. The energetic yield of aerobic glucose breakdown. The use of glucose for the synthesis of fats.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
64	Anaerobic glycolysis. Sequence of reactions, substrate phosphorylation. Distribution and physiological significance of anaerobic glycolysis.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
65	Glucose biosynthesis (gluconeogenesis) from amino acids, glycerol and lactic acid; regulation of gluconeogenesis. Biotin, role in the formation of oxaloacetate. The relationship of glycolysis in muscles and gluconeogenesis in the liver (Cory cycle).	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
66	Glycogen, biological significance. Biosynthesis and mobilization of glycogen. Regulation of glycogen synthesis and degradation.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
67	Blood glucose level as a homeostatic parameter of the internal environment of the body. The role of insulin, glucagon, adrenaline, adenylate cyclase and inositol phosphate systems in the regulation of glucose levels.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
68	Hereditary metabolic disorders of monosaccharides and disaccharides: galactosemia, intolerance to fructose and disaccharides. Glycogen storage diseases.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
69	Lipids. General characteristics. Biological role. Classification of lipids. Fatty acids, common features. Polyunsaturated fatty acids. Triacylglycerols, their structure and properties.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
70	Digestion of lipids. Absorption of digestion products. Disorders of digestion and absorption of lipids. Synthesis of lipids in the intestinal mucosal cells (resynthesis of triacylglycerols). Formation of chylomicrons and transport of fats. Lipoprotein lipase, its role.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
71	Plasma lipoproteins (LP), classification by density and electrophoretic mobility. Features of the structure and lipid composition. The main apolipoproteins, their functions. The functions of plasma LP, the place of formation and transformation of various types of LP. Hyperlipoproteinemia. Dyslipoproteinemia. Diagnostic value of determining the lipid spectrum of blood plasma.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
72	Deposition and mobilization of fats in adipose tissue, schemes of processes, the physiological role of these processes. Hormone sensitive lipase (diacylglycerol lipase). The role of insulin, adrenaline and glucagon in the regulation of fat metabolism.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
73	β -oxidation of fatty acids in the cell. Activation and transport of fatty acids to mitochondria. Reactions of β -oxidation of fatty acids, the energy yield on the example of the oxidation of stearic acid.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
74	Biosynthesis of fatty acids. The main stages of the process, scheme, enzymes. Regulation of fatty acid metabolism.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3

75	Ketone bodies. Ketogenesis and utilization of ketone bodies. Overproduction of ketone bodies: ketonemia and ketonuria. Causes of ketonemia and ketonuria during fasting and diabetes mellitus.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
76	Metabolism of cholesterol. Ways of admission, use and excretion from the body. Cholesterol biosynthesis. Regulation of cholesterol synthesis.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
77	The role of low and high density lipoproteins (LDL and HDL) in cholesterol metabolism. Biochemical basis of the development of atherosclerosis. Plasma cholesterol—biomedical importance.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
78	The general scheme of sources of intake and ways of spending amino acids in tissues. The dynamic state of proteins in the body. The reasons for the need for constant updating of body proteins. "Essential" amino acids.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
79	Catabolism of amino acids. General ways of amino acid degradation, scheme. Transamination of amino acids. The general scheme of reaction, the enzyme, the role of vitamin B ₆ , the biological significance of transamination. Clinical and diagnostic significance of determination of transaminases in blood serum.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
80	Deamination of amino acids: direct and indirect. Types of direct deamination. Oxidative deamination, Scheme of process, enzyme. Oxidases of L-amino acids. Glutamate dehydrogenase. Scheme of reaction, cofactor, enzyme, regulation of process.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
81	Indirect deamination of amino acids. Scheme of process, substrates, enzymes, cofactors, biological role.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
82	The main sources of ammonia in the human body. Toxicity of ammonia. The role of glutamine and asparagine in ammonia neutralization. Kidney glutaminase, formation and excretion of ammonium salts.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
83	Ornithine cycle of urea formation. Reactions, localization of the process in the cells. The energetics of the process, its regulation. Blood urea—clinical importance.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
84	Decarboxylation of amino acids. Biogenic amines: histamine, serotonin, GABA, putrescine. Reactions of their formation, enzymes, cofactor. Biological role of biogenic amines. Deamination and methylation of amines as ways of their neutralization.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
85	Metabolism of phenylalanine and tyrosine, scheme. Features of tyrosine metabolism in different tissues. Hereditary biochemical blocks in the breakdown of phenylalanine and tyrosine: parkinsonism, phenylketonuria, alkaptonuria, albinism, clinical manifestations.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
86	Endocrine, paracrine and autocrine systems of intercellular communication. The role of hormones in the system of regulation of metabolism. Hierarchy of regulatory systems. Regulation of hormone synthesis according to the feedback principle.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3

87	Classification of hormones by chemical structure, solubility, biological functions and place of synthesis.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
88	Target cells and cellular hormone receptors. Receptors of cytoplasmic membranes, receptors localized in the cytoplasm, receptors with their own tyrosine kinase activity. Regulation of the number and activity of receptors. Mechanisms of signal transduction by membrane receptors. The concept of G-proteins, types of α subunits of G-proteins.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
89	Cyclic AMP and GMP as secondary messengers. Activation of protein kinases and phosphorylation of proteins responsible for the hormonal effect.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
90	Phosphatidylinositol pathway as a mechanism of intracellular communication. Inositol 1,4,5-triphosphate and diacylglycerol are secondary messenger of signal transmission. Calcium ions as secondary messenger, calmodulin.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
91	Transmission of signals through intracellular receptors. Formation of the hormone-receptor complex and its interaction with DNA, hormone responsible elements (HRE). Transmission of signals through receptors coupled with ion channels. The structure of the H-cholinergic receptor.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
92	Hormones of the hypothalamus and anterior pituitary gland, chemical nature and biological role.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
93	Regulation of water-salt metabolism. Structure, mechanism of action and functions of aldosterone and vasopressin. The role of the renin-angiotensin-aldosterone system. Atrial natriuretic factor.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
94	Regulation of calcium and phosphate ion metabolism. The structure and mechanism of action of parathyroid hormone, calcitonin and calcitriol. Causes and manifestations of rickets, hypo- and hyperparathyroidism.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
95	Insulin-structure, stages of synthesis and secretion. Regulation of insulin synthesis and secretion. The mechanism of insulin action. The role of insulin and counterregulatory hormones (adrenaline and glucagon) in the regulation of metabolism. Changes in hormonal status and metabolism in diabetes mellitus. Diabetic coma.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
96	Thyroid hormones. Regulation of synthesis and secretion of iodothyronines and their effect on metabolism and body functions. Changes in metabolism in hypo- and hyperthyroidism. Causes and manifestations of endemic goiter.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
97	Hormones of the adrenal cortex (corticosteroids). Their effect on cell metabolism. Changes in metabolism in hypo- and hyperfunction of the adrenal cortex.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
98	Hormones of the adrenal medulla. Secretion of catecholamines. Mechanism of action and biological functions of catecholamines. Pathology of the adrenal medulla.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3

99	Metabolism of endogenous and foreign toxic substances. Microsomal oxidation reactions. The role of cytochrome P ₄₅₀ in the oxidation of xenobiotics. Schemes of oxidation processes of substances in the cytochrome P ₄₅₀ system. Induction of the cytochrome P ₄₅₀ system by drugs.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
100	Biotransformation of medicinal substances. The conjugation phase. Schemes of conjugation reactions with PAPS and UDP-glucuronic acid.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
101	Degradation of heme to bile pigments. The scheme and the localization of the process. Conjugation of bilirubin. Excretion of bilirubin into bile. Fate of bilirubin. "Direct" and "indirect" bilirubin. Diagnostic value of bilirubin determination in blood and urine.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
102	Disorders of heme catabolism. Jaundice: hemolytic, hepatic (hepatocellular), obstructive, neonatal-physiologic jaundice, jaundice due to genetic defects. Diagnostic value of the determination of bilirubin and urobilinoids in various types of jaundice, differential diagnostics of jaundice.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
103	Human hemoglobins, the structure of hemoglobin A. Transport of oxygen and carbon dioxide. Fetal hemoglobin and its physiological significance. Hemoglobinopathies.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
104	Biosynthesis of heme. The scheme of the process, the chemistry of the first two reactions, the place of occurrence. Regulation of the activity of enzymes ALA-synthase and ALA-dehydratase. Porphyrrias. Sources of iron for heme synthesis, iron absorption, transport in the blood, deposition.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
105	Serum proteins, the biological role of the main protein fractions, the importance of their determination for the diagnostics of diseases.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
106	Collagen: features of amino acid composition, primary and spatial structure. Features of collagen biosynthesis and maturation. The role of ascorbic acid in the maturation of collagen.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
107	The structure and functions of glycosaminoglycans (hyaluronic acid, chondroitin sulfates, heparin). The structure of proteoglycans.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
108	Structural organization of the extracellular matrix. Adhesive proteins of the extracellular matrix: fibronectin and laminin, their structure and functions.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
109	The molecular structure of myofibrils. Structure and function of the main proteins of myofibrils: myosin, actin, tropomyosin, troponin.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
110	Major biochemical events occurring during a cycle of muscle contraction and relaxation. The role of calcium ions and other ions in the regulation of muscle contraction of striated and smooth muscles.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
111	Sarcoplasmic proteins. Myoglobin, its structure and functions. Features of energy metabolism in muscles; the role of creatine phosphate and adenylate	UC-1.1, GPC-1.1,

	kinase.	GPC-2.1, PC-4.2, PC-4.3
112	Neurotransmitters of the nervous system: acetylcholine, catecholamines, serotonin, γ -aminobutyric acid, glycine, glutamate, histamine. Physiologically active brain peptides.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
113	The importance of water for the vital activity of the body. Distribution of water in tissues, the concept of intracellular and extracellular fluids. Water balance, regulation of water metabolism.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
114	Biochemical basis of medical biotechnology. Preparation of medicines by biotechnological synthesis (production of human insulin from pork). The role of biochemical knowledge in the processor approach and the creation of new drugs.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
115	Enzymes in medicine and pharmaceutical industry. Advantages of immobilized enzymes, methods of immobilization. Immobilization of whole cells.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
116	Biochemical bases of pharmacokinetics of medicines. Absorption, metabolism, distribution and isolation of drugs. Prodrugs. P-glycoprotein, its biological role.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
117	Biochemical bases of pharmacodynamics of medicines. Interaction of drugs with the receptor. Macromolecular nature of drug receptors. Ligand saturation curves of the receptor. Agonists and antagonists of receptors: competitive, partial and non-competitive. Signaling mechanisms and drug actions.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3
118	Photophosphorylation is the main pathway of ATP formation in green plants. Photosynthesis: the essence of the process, the general scheme of electron transfer. Photosystems I and II. Similarities and differences of oxidative and photophosphorylation systems.	UC-1.1, GPC-1.1, GPC-2.1, PC-4.2, PC-4.3

The full fund of assessment tools for discipline "Medical biochemistry" is available in the EIES of VolgSMU at the link (s):

<https://elearning.volgmed.ru/course/view.php?id=6299>

<https://elearning.volgmed.ru/course/view.php?id=6298>

Considered at the meeting of the department of Theoretical biochemistry with a course of clinical biochemistry "10" May 2023, protocol № 16

Head of the Department



O.V. Ostrovskij.