

1. Working programm of educational discipline

1.1. Explanatory note

The mission of ISM IUK is to train competent specialists in the field of medicine that meet international standards and traditions of medical ethics, ready for continuous professional growth using modern achievements of science and practice, to solve public health problems.

Annotation of the educational discipline

The tremendous advances in biological chemistry in recent years have touched the very foundations of natural science. Fundamental discoveries in the field of the structure of biopolymers, molecular mechanisms of storage and transmission of information, cloning of genes and the mechanism of biosynthesis of specific proteins, regulation of metabolic processes at the molecular, cellular and organismal levels served as the basis for the formation of new views on the essence of life processes. It is obvious that these advances in biochemistry should take an **шъзщкефте** place in the training of medical students.

Biological chemistry as a science of the vital activity of the human body should be as close as possible to the practical tasks of medicine. In this regard, the most important results of biological research of recent years were included in the program during its development and addition. Such fundamental concepts as molecular diseases, block mechanisms of metabolic disorders and a block of clinical modules were formulated.

Purpose and objectives of the discipline

Purpose of the discipline: on the basis of the achievements of modern biochemical science, to form students' systemic knowledge about

- structure and functions of the proteins, nucleic acids;
- biological role and mechanism of action
- vitamins, hormones and enzymes;
- regulation of gene expression;
- mechanisms of DNA, RNA and protein biogenesis;
- mechanisms of regulation of metabolism and the role of the hormone receptor system and secondary intracellular messengers in the transmission of nervous and hormonal signals;
- the chemical composition and metabolic processes in the specialized organs and tissues, such as blood, liver, kidneys, nervous, muscle, connective and bone to provide a theoretical basis for the professional activity of a general practitioner (family doctors).

Objectives of the discipline:

- Student should learn chemical composition of human organs and tissues, biochemical processes in the body, i.e. metabolism as a whole.
- Student should know normal ranges of biochemical indices, molecular basis of functions of human body.
- Student should be able to analyze results of biochemical tests to diagnose diseases and monitor an effectiveness of treatment.
- Student should master modern biochemical methods of analyses and apply them in practice.

The place of discipline in the structure of the main professional educational program of HPE.

Discipline "General and Clinical Biochemistry" refers to block B-3, basic part of the professional cycle.

Since biochemistry belongs to integrated disciplines that covers chemical processes and molecular mechanisms supporting life, students are required to possess the basic knowledge in the following fields:

- **Chemistry:** knowledge on atomic and elementary structure of molecules of organic compounds, their physico-chemical properties and mechanisms of chemical reactions. Skills on working with chemical reagents and equipment, ability to analyze and interpret results, completing protocols of laboratory tests.
- **Biology:** knowledge on structure and functioning of a cell and intracellular organelles, role of cell compartmentalization; assembling from cells to organisms; molecular basis of mutations and evolution, biological diversity. Skills on working with biological material.
- **Physics and mathematics:** knowledge on fundamental physical processes and phenomena. Skills on working with technical devices and equipment.
- **Philosophy and ethics:** knowledge on ethical principles of relationship and moral obligation to patients.
- **Information technologies:** ability to work with Internet and educational resources

The results of mastering the discipline "Biological Chemistry" are used in the following disciplines:

- **Genetics;**
- **Physiology;**
- **Immunology.**
- **Histology.**
- **Cytology.**

Competencies of students, formed as a result of mastering the discipline, the planned results of mastering the discipline

A graduate in the specialty "General Medicine" with the assignment of the qualification of a specialist "General Physician" in accordance with the State Educational Standard of Higher Professional Education and General Education and the tasks of professional activity, must have the following professional competencies:

Code	Content of competence
ПІК-7	is able and ready to work with medical and technical equipment used in working with patients, to own computer equipment, to receive information from various sources, to work with information in global computer networks, to use the capabilities of modern information technologies to solve professional problems.
ПІК-14	able and ready to make a diagnosis based on the results of biochemical and clinical studies, taking into account the course of pathology in organs, systems and the body as a whole. ble and ready to make a diagnosis based on the results of biochemical and clinical studies, taking into account the course of pathology in organs, systems and the body as a whole.

After mastering the discipline "General and Clinical Biochemistry" the student:

will know

- safety regulations and work in biochemical laboratories with reagents, devices, animals;
- physicochemical essence of the processes occurring in a living organism at the molecular, cellular, tissue and organ levels;
- principles of implementation of methods for determining the concentration of individual substrates and the activity of enzymes in biological material;
- the main metabolic pathways for the conversion of carbohydrates, lipids, amino acids, purine and pyrimidine bases, the role of cell membranes and their transport systems in metabolism;
- structure and functions of the most important chemical compounds (nucleic acids, natural proteins, water-soluble and fat-soluble vitamins, hormones, etc.);
- physicochemical methods of analysis in medicine (chromatography, spectrophotometry, electrophoresis, blotting, etc.);
- general patterns of structure and functioning of cells, tissues and the whole organism in health and disease;
- basic biochemical mechanisms of development of diseases in humans, including hereditary ones;

- using the capabilities of modern biochemical methods in laboratory diagnostics of diseases;
- basic methods used in biochemistry;

will be able

- use educational, scientific, popular science literature, the Internet and an educational portal for professional activities;
- independently stage a simple biochemical experiment and give a critical assessment of this experiment.
- work with devices when performing biochemical studies: FEC, refractometer, polarimeter, spectrophotometer, pH meter, apparatus for electrophoresis, chromatography methods, etc.
- identify infectious agents by PCR analysis.
- determine the activity of enzymes in biological objects.
- to determine the amount of proteins and their fractions in blood plasma.
- to determine the content of vitamins in products of plant and animal origin.
- to determine the content of some components of carbohydrate, lipid, protein metabolism in biological objects (urea, uric acid, bilirubin, glucose, total lipids, cholesterol, beta lipoproteins, etc.)
- determine the acidity of gastric juice.
- calculate the results of the analysis and carry out mathematical processing of the results.
- to select an approximate set of biochemical determinations for the analysis of blood, urine in certain pathological conditions (diabetes mellitus, gastric ulcer, duodenal ulcer, liver, kidney, heart, connective tissue, etc.).

1.2. Recommended educational technologies

For the development of students of the academic discipline "General and Clinical Biochemistry", the acquisition of knowledge and the formation of professional competencies, the following educational technologies are used:

lecture-electronic presentation,

- problem based lecture,
- lesson-conference,
- training,
- brainstorm,
- small group method,
- participation in scientific and practical conferences, congresses, symposia,
- research work of a student,
- written analytical work
- preparation and defense of abstracts,
- distance educational technologies.

1.3. Total volume and types of educational work

Course	Semester	Credits	Academic hours		Individual work		Total hours in the semester
			Lecture	Practise class	SIW	SIWT	
2	2	2	18h.	18h.	16h	8h.	60h.
3	3	5	36h.	54h.	20h.	40h.	150h
3	4,5	1	14h.	16h.	-	-	30h.
Total		6	68h.	88h.	36h.	48h.	240h.

1.4. Time consuming and structure of discipline “General and clinical biochemistry”

№	Name sections and topics disciplines (lectures and practical exercises)	Classroom lessons				Total for classroom work	SIWT	SIW	FFrmed competences	Used educational technologies, methods and methods of teaching	Forms of current and midterm control academic performance
		Lecture	Seminars	Practical lessons	Experomental work						
Semester 2											
1	Modul 1 Proteins. Enzymes.	10		6	2	18	4	8	ПК-7, ПК-14.	ЛВ/ПЛ 3К, Р	Пр, КЗ, КР, Т.
2	Modul 2 Vitamins. Hormones.	8		8	2	18	4	8	ПК-7, ПК-14.	ЛВ/ПЛ 3К, Р	Пр, КЗ, КР, Т.
	Total	18		14	4	36	8	16			
Semester 3											
3	Modul 1 Biological oxidation. Metabolism of carbohydrates.	8		10	2	20	6	9	ПК-7, ПК-14.	ЛВ/ПЛ 3К, Р	Пр, КЗ, КР, Т.
4	Modul 2. Metabolism of lipids. Metabolism of amino acids..	14		12	2	28	6	9	ПК-7, ПК-14.	ЛВ/ПЛ 3К, Р	Пр, КЗ, КР, Т.
5	Modul 3 Metabolism of nucleotides. Transmission of genetic information.. Water and salt etabolism.	6		10	2	18	6	9	ПК-7, ПК-14.	ЛВ/ПЛ 3К, Р	Пр, КЗ, КР, Т.

	Biochemistry of the kidneys..									
6	Modul 4 Biochemistry of blood. Biochemistry of liver. Biochemistry of specialized tissues.	8	12	4	24	6	9	ПК-7, ПК-14.	ЛВ/ПЛ 3К, Р	Пр, КЗ, КР, Т.
	Total	36h	44h	54h	90h	24h	36h			

	Name of system	Academic hours				FFirmed competences	Used educational technologies, methods and methods of teaching	Forms of current and midterm control academic performance
		Lecture	Practical classe	SIW	SIWT			
Semester 4								
1	Hematology	2	2	-	-	ПК-7, ПК-14.	Л, ЛВ, 3К	3С, Т, К3
2	Endocrinology	2	-	-	-	ПК-7, ПК-14.	Л, ЛВ, 3К	3С, Т, К3
3	Reproductive system	2	-	-	-	ПК-7, ПК-14.	Л, ЛВ, 3К	3С, Т, К3
	Total	6	2					
Semester 5								
1	Nervous system	2	2	-	-	ПК-11, ПК-27.	Л, ЛВ, 3К	3С, Т, К3
2	GIT	2	8	-	-	ПК-11, ПК-27.	Л, ЛВ, 3К	3С, Т, К3
3	Urinary system	2	4	-	-	ПК-11, ПК-27.	Л, ЛВ, 3К	3С, Т, К3
4	SMS	2	2	-	-	ПК-11, ПК-27.	Л, ЛВ, 3К	3С, Т, К3
	Total	8	16	-	-	ПК-11, ПК-27.	Л, ЛВ, 3К	3С, Т, К3
	Total for semester 4, 5.	14	18	-	-			

Thematic plan of lectures

Semester 2

№	Topic of lectures	Hours
1	Introduction to biochemistry. Simple and complex proteins.	2
2.	Enzymes. Classification of enzymes. Kinetics of enzymatic reactions.	2
3.	Regulation of enzyme activity. Usage of enzymes in medicine.	2
4.	Vitamins. Fat soluble vitamins.	2
5.	Water soluble vitamins 1.	2
6.	Water soluble vitamins 2.	2
7.	Regulation of metabolism. Hormones of hypothalamus and hypophysis.	2
8.	Hormones of thyroid gland and pancreas.	2
9.	Hormones of adrenal glands. Sex hormones.	2
Total		18

Semester 3

№	Topic of lectures	Hours
1.	Biological oxidation. Oxidative phosphorylation.	2
2.	Metabolism of carbohydrates I. Digestion and absorption. metabolism of glycogen.	2
3.	Metabolism of carbohydrates II. Anaerobic and aerobic glycolysis.	2
4.	Digestion and absorption of lipids. Lipolysis. β – oxidation of fatty acids.	2
5.	Biosynthesis of lipids: biosynthesis of fatty acids, triacylglycerols and phospholipids.	2
6.	Hormonal regulation of lipid metabolism. Disorders of lipid metabolism: obesity, atherosclerosis, ketonemia and ketonuria.	2
7.	Metabolism of simple proteins. Digestion of proteins in GIT. Intermediate metabolism of amino acids.	2
8.	Specific ways of amino acids metabolism. Urea cycle.	2
9.	Pathology of nitrogen metabolism.: aminoaciduria, Wilson's disease, alcaptonuria.	2
10.	Metabolism of nucleotides. Biosynthesis and degradation of purine and pyrimidine nucleotides/ disorders of metabolism.	2
11.	Transmission of genetic information. Biosynthesis of nucleic acids and proteins.	2
12.	Water salt metabolism and biochemistry of kidneys. Regulation of water and salt metabolism. Feature of metabolism in the renal tissue.	2
13.	Biochemistry of blood. The chemical composition of blood: proteins, enzymes, blood plasma lipoproteins. Azotemia, types of azotemia.	2
14.	Biochemistry of liver. The role of the liver in carbohydrate, lipid, protein metabolism.	2

15.	The role of liver in pigment metabolism. The role of the liver in bile formation.	2
16.	Biochemistry of the nervous tissue. Features of the metabolism of carbohydrates, lipids and proteins in the brain.	2
17.	Biochemistry of muscle tissue. Conversion of chemical energy into energy of mechanical motion.	2
18.	Biochemistry of connective tissue. Connective tissue proteins. Proteoglycans from structure and function. Biochemistry of bone tissue. Features of bone metabolism.	2
Total		36h

Semester 4

	Theme of lecture	Hours
1.	Impaired metabolism of hemoproteins, porphyrins and iron.	2h.
2.	Biochemical changes in the pathology of the endocrine system.	2h.
3.	Biochemical changes in the pathology of the reproductive system.	2h.
Total		6h.

Semester 5

№	Theme of lecture	Hours
1.	Biochemical changes in diseases of the nervous system.	2h
2.	Biochemical changes in the pathology of the stomach, pancreas, intestines and their research methods.	2h
3.	Features of metabolism in the liver in pathology. Biochemical methods for assessing liver function.	2h
4.	Biochemical changes in the pathology of the urinary system.	2h
5.	Biochemical changes in violation of the function of the musculoskeletal system	2h
Total		10h.

Thematic plane of practice classes

Semester 2

№	Theme of lesson	Hours
1.	Introduction. The subject and tasks of biochemistry. Amino acid composition of proteins. Structural organization of proteins, their molecules. Physicochemical properties of proteins: denaturation, dialysis, isoelectric point of proteins. Chemistry of simple and complex proteins. Practical work: Color reactions to amino acids and proteins. Protein denaturation. Protein dialysis.	2

2.	Ферменты. Физико-химические свойства ферментов Классификация и номенклатура ферментов. Специфичность ферментов, ее виды. Типы ферментов. Практическая работа: Ферментативный гидролиз крахмала амилазой слюны. Определение специфичности амилазы.	2
3.	Kinetics of enzymatic reactions. Thermal stability, influence of the pH of the medium. Enzyme activation and inhibition. Inhibition types: reversible and irreversible inhibition. Competitive and non-competitive inhibition. Medical Engzimology. Practical work: Influence of temperature and pH of the medium on the activity of salivary amylase.	2
4.	Modul 1	2
5.	Vitamins. Fat-soluble vitamins. The structure and biological role of vitamins A, D, E and K. Distribution in nature and daily requirement. Practical work: Qualitative reactions to vitamins A, D, E and vicasol.	2
6.	Coenzyme function of water-soluble vitamins: structure, NAD, FAD, FMN, TPP, PLP, NAD ⁺ and NADP ⁺ . Sources, daily requirement and biological role of vitamins B ₁ , B ₂ , B ₆ , PP. B ₁₂ , B ₃ , C. Practical work: Qualitative reactions to vitamins B ₁ and B ₂ .	2
7.	General characteristics of hormones. Mechanisms of hormone action. Hormones of the hypothalamic-pituitary system. Pathological processes associated with a violation of their functions. Hormones of the posterior lobe of the pituitary gland. Vasopressin and oxytocin: structure, biological functions. Pathology associated with impaired vasopressin production.	2
8.	Thyroid hormones. Parathyroid hormones. Pancreatic hormones. Adrenal medulla hormones, functional significance and role of metabolites. Steroid hormones. Adrenal cortex hormones. Male and female sex hormones. Practical work: Qualitative reactions to insulin.	2
9.	Modul 2	2
Total		18h

Thematic plane of practice classes

Semester 3

Week	№ lesson	Theme of lesson	Hours
1	1.	Biological oxidation. Enzymes and coenzymes of tissue respiration. The biological oxidation chain is the points of ATP formation. Shortened respiratory chain. Mitchell oxidative phosphorylation	2

		mechanism (scheme). Regulation of energy metabolism: respiratory control, thyroxine. Practical work: Quantitative determination of blood catalase.	
2.	2.	Metabolism of carbohydrates. Digestion and absorption of carbohydrates. Ways of using glucose-6-phosphate in the body. Glycogen synthesis, the role of UTP, glycogen synthase. Cascade mechanism of glycogen breakdown, the role of adenylate cyclase, cAMP and ATP in the process of phosphorylase "B" activation. The role of adrenaline and glucagon.	2
	3.	Glycolysis is the anaerobic and aerobic breakdown of glucose. Glycolytic oxidoreduction, substrate phosphorylation in glycolysis. Energy balance of anaerobic glucose oxidation. Incorporation of fructose and galactose into glycolysis. Fructosuria and galactosemia, their causes. Alcoholic fermentation. Practical work: Determination of the content of pyruvic acid and lactic acid in biological fluids.	2
3.	4.	Aerobic metabolism of pyruvate. Mechanism of oxidative decarboxylation of pyruvate. Krebs cycle, its meaning, sequence of reactions and end products. Energy balance of aerobic glycolysis. Gluconeogenesis: substrates, key enzymes, reactions, intramolecular localization, physiological significance of the process. Glucose-lactate and glucose-alanine cycles.	2
4.	5.	Pentose phosphate pathway of glucose oxidation, its main stages, biological role. Effects and mechanisms of influence of glucagon, adrenaline, glucocorticoids, growth hormone and insulin on blood glucose levels. Disorders of carbohydrate metabolism. Hereditary disorders of glycogen metabolism (glycogenosis and aglycogenosis). Practical work: Determination of glucose concentration in blood by glucose oxidase method.	2
	6.	Modul 1	2
5.	7.	Lipid metabolism. The most important tissue lipids. Classification of lipids, their structure, biopoly. Decomposition and resynthesis of triacylglycerols. Features of absorption and transport of lipids. Intracellular lipolysis. Practical work. Kinetics of lipase action.	2
6.	8.	Metabolism of ketone bodies. Biological role of ketone bodies. Biosynthesis of IVA and phospholipids in various tissues. Mechanism of transfer of acetyl-CoA from mitochondria to cytosol. Role of HS-ACP, malonyl-ACP and biotin. Biosynthesis of triacylglycerols. The role of phosphatidic acid. The mechanism of phospholipid biosynthesis. Role of CTF and S - adenosylmethionine and choline.	2
	9.	Cholesterol biosynthesis, the role of NADPH-dependent OMG-CoA reductase. Lipoprotein fractions and their functions. Lipid metabolism pathologies: steatorrhea, obesity, atherosclerosis, hyperlipoproteinemia. Violation of lipid metabolism in obesity, diabetes mellitus. Practical work: Determination of serum cholesterol content.	2

7.	10.	Protein and amino acid metabolism. The biological value of proteins. Nitrogen balance. Digestion of proteins in the gastrointestinal tract. The fate of the absorbed amino acids. The transformation of AMK under the influence of intestinal microflora and the ways of their neutralization. Role of FAFS and UDFC. Diagnostic value of analyzes of gastric juice and duodenal contents. Practical work: Determination of free and total acidity of gastric juice.	2
8.	11.	Intermediate exchange of amino acids: deamination - reductive, hydrolytic, intramolecular, oxidative. Deamination with the participation of L and D-oxidases and NAD dehydrogenases. Transamination of amino acids. The mechanism of the transamination reaction. The clinical significance of determining the activity of transaminases in the blood. Decarboxylation of AMK. Decomposition of biogenic amines. Role of MAO. Neutralization of ammonia in tissues, ornithine cycle of urea formation Practical work: Determination of the activity of AsAt and AlAt in blood serum.	2
	12.	Specific pathways for the exchange of individual amino acids: glycine, serine, cysteine, methionine, phenylalanine and tyrosine, tryptophan, histidine, dicarboxylic amino acids and their amides, the exchange of branched-chain amino acids. Synthesis of creatinine. Pathology of nitrogen metabolism. Pathology of protein and amino acid metabolism.	2
9.	13.	Modul 2	2
10.	14.	Metabolism of complex proteins. Biosynthesis and degradation of purine and pyrimidine nucleotides. Synthesis of AMP, HMP from IMP. Synthesis of UMF, TMP, CMF. The role of xanthine oxidase. Uric acid as an end product of the breakdown of purine nucleotides. Violation of the exchange of purine nucleotides (gout, Lesch-Nihan syndrome). Oratoaciduria. Practical work. Quantification of uric acid in urine.	2
	15.	Three stages of the implementation of genetic information. Biosynthesis of nucleic acids and NK degradation. Replication, repair, transcription. The role of biochemical research in medicine and the use of DNA technologies. Problems of genetic engineering. The flow of genetic information.	2
11.	16.	Protein synthesis (translation) Genetic code. Components of the protein synthesis system. Stages of protein biosynthesis: activation of AMK, initiation, elongation, termination and postsynthetic modification. Protein synthesis inhibitors. Regulation of protein synthesis: enzyme induction and enzyme repression.	2
12.	17.	The biological value of water, its content, the daily requirement of the body. The water is exogenous and endogenous. Properties and biochemical functions of water. Distribution and state of water in the body. Water exchange in the body, age characteristics, regulation. Water balance of the body and its types. The functions of mineral salts in the body. Neurohumoral regulation of water-salt metabolism. Electrolyte composition of body fluids, its regulation.	2

	18.	<p>Functions of the kidneys and peculiarities of metabolism in them. Biochemical mechanisms of kidney function regulation. General properties and chemical composition of normal urine. The value of research in the clinic. Organic and inorganic substances of normal urine. Physicochemical indicators of urine: urine output, relative density, pH, odor, color, transparency.</p> <p>Practical work. Qualitative reactions to pathological components of urine: protein, glucose, bile pigments, ketone bodies, blood pigments.</p>	2
13.	19.	Modul 3	2
14.	20.	<p>Blood and its function. The chemical composition of the blood: blood plasma proteins. Electropherogram of blood serum proteins and their functions. Hypo-, hyperproteinemia. Dysproteinemia and paraproteinemia and their causes. Plasma lipoproteins, their structure, properties and functions. Blood plasma enzymes. Plasma nitrogenous non-protein substances. Azotemia, types of azotemia. Mineral components of blood. Respiratory function of blood. Buffer systems of blood plasma.</p>	2
	21.	<p>Liver biochemistry. The chemical composition and function of the liver. The role of the liver in carbohydrate, protein and lipid metabolism. The role of glucokinase, glucose-6-phosphate, glycogen in maintaining glucose homeostasis in the body. The value of beta-hydroxy, beta-methyl-glutaryl-CoA in the regulation of lipid metabolism in the liver.</p> <p>Practical work. Determination of the activity of AsAt and AlAt / transaminases / in blood serum.</p>	2
15.	22.	<p>The role of the liver in the detoxification process. Role of FAFS and UDFGK in detoxification of various substances in the liver. Microsomal oxidation and its significance. The role of the liver in pigment metabolism. Clinical determination of bilirubin and its fraction. The role of the liver in bile formation, the chemical composition of bile and the causes of cholelithiasis.</p> <p>Practical work. Qualitative reactions to bile pigments.</p>	2
16.	23.	<p>Biochemistry of the nervous tissue. Mechanism of nerve impulses: synthesis of acetylcholine and its breakdown. Features of the metabolism of carbohydrates, lipids and proteins in the brain. Enzymes and nucleotides of the brain, and their role. Ways to neutralize ammonia, the formation of GABA and the source of glutamate in the brain.</p>	2
	24.	<p>Biochemistry of muscle tissue. Types and chemical composition of muscles. Muscle proteins. Anserine and carnosine, their structure and function. Conversion of chemical energy into energy of mechanical motion.</p>	
17.	25.	<p>Biochemistry of connective tissue. Structural features and biorol of connective tissue. Connective tissue proteins: elastin, collagen, proteoglycans and their functions. structural features of elastin. Proteinglycans. Cellular elements of bone tissue: osteoblasts and osteoclasts. Biochemistry of bone tissue. The chemical composition of bone tissue.</p> <p>Practical work. Quantification of free hydroxyproline in urine and sialic acids.</p>	2

18.	26.	Modul 4	2
	27.	Concluding lesson	2
Total			54h.

Semester 4

№	Theme of lesson	Hours
1	Iron metabolism in the body. Regulation of apoferritin synthesis. Iron metabolism disorders. Hemochromatosis. Porphyrrias. Diagnostic tests for the determination of iron in the body.	2h.
Total		2h.

Semester 5

1	Biochemical changes in diseases of the nervous system. Disorders of lipid, carbohydrate, protein, energy metabolism in the nervous system.	2h.
2	Biochemical changes in the pathology of the stomach, exocrine function of the pancreas, intestines and their research methods.	2h.
3	Features of metabolism in the liver in pathology. Biochemical methods for assessing liver function.	2h.
4	Biochemical changes in the pathology of the urinary system. Chronic renal failure, acute renal failure, metabolic disorders.	4h.
5	Biochemical changes in violation of the function of the musculoskeletal system. Basic indicator tests. Violation of energy metabolism in the muscles.	2h.
Total		14 h.

Abbreviation of the designations of educational technologies, methods and methods of teaching: traditional lecture (L), lecture-visualization (LP), problem lecture (LP), lecture-press conference (LPK), lesson-conference (LC), training (T), debates (D), brainstorming (MS), master class (MC), round table (CC), activation of creative activity (ATD), regulated discussion (RD), forum type discussion (F), business and role-based educational game (CI, RI), small group method (MG), exercises using simulators, simulators (Tr), computer simulation (CS), clinical case analysis (CS), the use of computer training programs (CPC), interactive atlases (IA), participation in scientific and practical conferences (NPK), congresses, symposia (Sim), student's educational research work (UIRS), conducting subject Olympiads (O), preparation of written analytical papers (AR), preparation and defense of abstracts (P), design technology (PT), excursions (E), distance educational technologies (DOT).

Reducing the forms of current and midterm monitoring of progress: T - testing, Pr - assessment of the development of practical skills (abilities), 3C - solving situational problems, KP - control work, K3 - control task, R - writing and defense of the abstract, S - interview on control tests issues, D - preparation of a report, etc.

1.4.2. Organization of students' independent work**1.4.3. Thematic plan of the student's independent work (SIW) in the discipline "General Biochemistry"*****Semester 2***

Theme of SIW	Task for SIW	Hours	Litreture	Dead line	Max points
Structural proteins and complex proteins.	Making a cross word.	3	Marks Dawn B. Biochemistry. 1994. P. 23–30. Murray R. K. Harper's illustrated biochemistry. 2006. P. 14–20, 30–40.	1	10
Using of enzymes in medicine.	Presentation	5	Chatterjea M. N. Textbook of medical biochemistry 2007. P. 81–83, 139–150, 203–213, 225–232. Murray R. K. Harper's illustrated biochemistry, 2006. P. 41–49, 294–300, 311–321, 523–545.	2	10
Vitamin-like compounds.	Filling up the table.	4	Marks Dawn B. Biochemistry, 1994. P. 56. Murray R. K. Harper's illustrated biochemistry, 2006. – P. 82–97.	2	10
Diabetes insipidus and its types.	Report.	4	Marks Dawn B. Biochemistry, 1994. P. 33–34, 106–109. Chatterjea M. N. Textbook of medical 2007. P. 114–116.	2	10

Semester 3

Theme of SIW	Task for SIW	Hours	Litreture	Dead line	Max points
Carbohydrates of the human tissues.	Making MCQs.	5	Marks Dawn B. Biochemistry, 1994. – P. 131–138, 149–156. Chatterjea M. N. Textbook of medical biochemistry, 2007. P. 303–312.	2	10
Lipids of the human tissues.	Making the a brief concept.	4	Marks Dawn B. Biochemistry, 1994. P. 185–189, 197–198.	1	10

			Murray R. K. Harper's illustrated biochemistry, 2006. P. 121–131, 422–441.		
Disorders of lipid metabolism.	Making the glossary.	4	Chatterjea M. N. Textbook of medical biochemistry, 2007. P. 405–424. Murray R. K. Harper's illustrated biochemistry, 2006. P. 217–224, 230–238.	2	10
The main stages of protein metabolism and their characteristics.	Making a cross word. .	6	Murray R. K. Harper's illustrated biochemistry, 2006. P. 187–195.	3	10
Genetic Engineering.	Presentation.	6	Marks Dawn B. Biochemistry, 1994. P. 202–208.	1	10
Biochemistry of kidneys. Metabolism of phosphates and calcium. Role of hormones and vitamins its regulation.	Составление тестовых заданий.	4	Marks Dawn B. Biochemistry, 1994. P. 202–208. Chatterjea M. N. Textbook of medical, 2007. P. 381–388, 398–405.	1	10
Biochemistry of blood.	Assay.	4	Marks Dawn B. Biochemistry / Dawn B. Marks. – Baltimore, Philadelphia : Williams & Wilkins, 1994. – P. 202–208.	1	10
Biochemistry of connective tissue.	Report.	4	Chatterjea M. N. Textbook of medical, 2007. P. 381–388, 398–405.	1	10
Biochemistry of nervous tissue.	Makins MCQs.	2	Murray R. K. Harper's illustrated biochemistry, 2006. – P. 187–195.	1	10

1.4.3. Evaluative Assessment Tools

- **Current and milestone (modul) control**

The current control of students' knowledge can be:

- oral questioning;
- checking the completion of written homework;
- checking abstracts, essays, reports;

Approximate topics of reports, abstracts, scientific reviews, research projects:

- Biochemical mechanisms of stress development and their role in the formation of pathology:
 - protein metabolism
 - carbohydrate metabolism
 - lipid metabolism;
- Biochemical assessment of oxidative stress and antioxidant protection;
- New biochemical markers of cardiovascular pathology;
- Modern markers of connective tissue damage;
- Biochemical markers of bone resorption and synthesis;
- Biochemical mechanisms of development of the inflammatory reaction;
- Modern biochemical equipment and research laboratory equipment;
- Biochemical mechanisms of insulin resistance development;
- Peculiarities of protein metabolism in children;
- Peculiarities of lipid metabolism in children;
- Peculiarities of carbohydrate metabolism in children;

Examples of evaluation means

1. Regular or final computer-based or blank testing	<ol style="list-style-type: none"> Which protein has catalytic activity? <ol style="list-style-type: none"> Albumin Pyruvate kinase Hemoglobin Immunoglobulin G Which compounds do not function as a co-enzyme? <ol style="list-style-type: none"> NAD^+ and NADP^+ FAD and FMN Ascorbic acid and THFA Insulin and glucagon Which reaction is catalyzed by glucose-6-phosphatase? <ol style="list-style-type: none"> Phosphorylation of glucose Cleavage of peptide bond Hydrolysis of glucose-6-phosphate to glucose Isomerization of glucose -6-phosphate to fructose-6-phosphate
2. Written control work	<p>Structure, functions and properties of proteins.</p> <ol style="list-style-type: none"> Primary structure of proteins. Properties of peptide bond. Functions of proteins. Isoelectric properties of proteins. Influence of pH on summery charge of proteins. Factors that cause protein denature. Structure of hemoglobin. Show structure of heme.
	<p>Enzymes:</p> <ol style="list-style-type: none"> Structure of simple and complex enzymes. Active site of enzymes. Specificity of enzymes. Types of specificity. Michaelis-Menten theory of enzymatic catalysis. Inhibition of enzymatic activity: types of inhibition. Types of enzymes.
MODUL	<p>Variant 1.</p> <ol style="list-style-type: none"> Write the structure of the following tripeptide Ser-val-leu List all methods of separation of proteins, and describe each of them. What are the activators and inhibitors. Enzyme inhibition: Reversible and irreversible, allosteric inhibition. Give examples. What are the primary, secondary and tertiary structures of nucleic acids. What bonds responsible for maintain these structures.

	<p>5. Vitamin C. Biochemical functions. Daily requirements, dietary sources. Deficiency symptoms of vitamin C.</p> <p style="text-align: center;">Variant 2.</p> <ol style="list-style-type: none"> 1. Write the structure of the following tripeptide His-met-ser. 2. The levels of organization of the protein structure: primary, secondary, tertiary and quaternary structures. 3. Write the structures of the pyrimidine nitrogenous bases. 4. What are the isoenzymes? Diagnostic importance of isoenzymes. Give an example. 5. Vitamin A, the chemistry of vision. Dietary deficiency: night blindness, xerophthalmia, keratomalacia. Hypervitaminosis. <p style="text-align: center;">Variant 3.</p> <ol style="list-style-type: none"> 1. Structure tripalmitoylglycerol, and its biological role. 2. Write the reaction of formation of butyryl – ACP in the process of fatty acids biosynthesis. 3. Formation of indol in the intestine and its detoxification in the liver. 4. Biosynthesis of catecholamines (epinephrine and norepinephrine), their biological effect and uses in medicine. 5. Detoxification of ammonia in the tissues. Write the reactions of asparagine and glutamine formation. <p style="text-align: center;">Variant 4.</p> <ol style="list-style-type: none"> 1. Digestion of lipids in the GIT, role of bile salts. 2. Biosynthesis of phosphatidylcholine (lecithin), role of S – adenosyl methionine. 3. Digestion of proteins in the intestine. Protease of pancreatic juice, their activation and mechanism of action. 4. Write the reaction of serotonin formation and its biological effects. 5. Mechanism detoxification of phenol by UDP-glucuronic acid.
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• Final control

The final control at the end of the study of an academic discipline is carried out in the form of a test, which is set on the basis of the results of midterm (modular) control in the discipline.

1.4.4. Course policy and assessment criteria

The control of students' knowledge is carried out according to the point-rating system in accordance with the standard "Regulations on the modular point-rating

system for assessing the knowledge of students at the NOU UNPK" International University of Kyrgyzstan ".

The discipline "General Biochemistry" includes 6 modules, each module is evaluated on a 100 point system:

Maximum score -100, of which:

- attendance - 20 points;
- current control - 40 points (20 points - for classroom work, 20 points - for independent work),
- midterm control (delivery of the module) - 40 points.

The results of the modules are added up and the average score is displayed.

Scoring Policy	Modul 1	Modul 2
Посещаемость	20 points	20 points
Classroom work (activity in discussions, during oral questioning, working with a glossary, etc.)	20 points	20 points
Independent work: essay, report	20 points	20 points
Total by module (testing)	40 points	40 points
Total by discipline:	More then 60 points	

Final control in the form of offset is carried out based on the results of attendance, current and midterm (modular) control.

Final control form - offset.

To assess the student's progress, the following scale of correspondence between grades and points is used:

Scale of correspondence of grades and points				
Max points	Intervals			
	«unsatisfactory»	«satisfactory»	«good»	«excellent»
20	0-11	12-15	16-17	18-20
40	0-23	24-30	31-35	36-40
60	0-35	36-45	46-53	54-60
100	0-59	60-75	76-89	90-100

1.4.5. Educational-methodical and informational support of the discipline

A list of sources and textbooks:

Main textbooks:

1. Biochemistry, Dr. U. Satyanarayana, Dr. U. Chakrapani, Fourth Revised Edition: New Delhi, 2013.
2. Biochemistry and Medical Genetics, Published by Kaplan Medical, a division of Kaplan, Inc. New York, 2017.
3. Biochemistry (Lippincott's Illustrated Reviews), Denise R Ferrier , Lippincott Williams and Wilkins. 2014.

Further reading:

1. Lehninger Principles of Biochemistry, David L. Nelson, Michael M. Cox. W H. Freeman & Co (Sd). 2008.
2. Biochemistry (Stryer), Jeremy M. Berg , John L. Tymoczko , Lubert Stryer, W. H. Freeman. 2006.
3. Harper's Illustrated Biochemistry, Murray, R., D. Bender, K. Botham, P. Kennely, V. Rodwell, P. Well (2009) McGraw-Hill Medical, New York, 28th edn.
4. Северин Е.С., Биохимия. «Высшая школа» – Москва. - 2008.
5. Березов Т.Т., Коровкин Б.Ф. – Биологическая химия– ‘Медицина’. - Москва. – 2007.
6. Introduction to General, Organic, and Biochemistry, Eighth Edition, Frederick A. Bettelheim, William H. Brown, Mary K. Campbell, Shawn O. Farrell, Belmont, USA, 2007.
7. Biochemistry / Dawn B. Marks. – Baltimore, Philadelphia, Williams & Wilkins, 1994. – P. 34–35.
8. Harper's illustrated biochemistry / R. K. Murray, D. K. Granner, V. W. Rodwell. – 27th edition. – Lange Medical Books / McGraw-Hill, 2006. – P. 57–58, 61–72.

The list of resources of the information and telecommunication network "Internet" necessary for mastering the discipline

1. National Center for Biotechnology Information (NCBI)
- www.ncbi.nlm.nih.gov
2. Science Direct - <http://www.sciencedirect.com>

1.4.6. Material and technical support of the discipline.

Description of the material and technical base necessary for the implementation of the educational process on the discipline.

In accordance with the requirements of **ESPC IUK** the department of Fundamental Sciences has a specially equipped classroom for lectures on student flows, rooms for laboratory work for a group of 26 students and an auxiliary room for the storage of chemical reagents and preventive maintenance of educational and scientific equipment.

The lecture room is equipped with a set of electrical power supply of switchboard (220 V, 2 kW, complete with RCD), specialized furniture and organizational means (classroom board for writing with chalk and felt-tip pen, stand-chair, lecturer table, chair-chair, classroom tables, classroom chair, as well as teaching aids (wall-mounted with electric drive and remote control, multimedia projector with a laptop).

Laboratory classes are conducted in specially equipped laboratories with the use of necessary teaching aids (laboratory equipment, samples, regulatory and technical documents, etc.).

The premises of laboratory workshops are equipped with special educational and laboratory furniture (including tables with chemically resistant coatings), teaching and research laboratory equipment, and measuring instruments.

Methodical provision of lectures:

- thesis of lectures
- multimedia lectures
- codegrams of lectures

The list of information technologies used in the implementation of the educational process.

Table 1. List of posters (by topic), maps, stands, presentations.

№ п/п	Type	Name	Note
1.	Videos	Biochemistry of qualitative reactions for the determination of proteins, carbohydrates, nucleic acids, lipids, vitamins, enzymes, hormones, Krebs cycle, glycolysis, metabolism proteins, lipid metabolism, carbohydrate metabolism, tissue respiration, the role of water in the body	10 – 60 minuts
2.	Presentations	For all the lecture course	20 - 30 slids in presentation
3.	Written and test works	For all the lecture course	In significant quantity

List of used rooms

Table 2.

Room №	Types of room	Equipment list
201	Auditorium for lecture-type classes.	Стационарный мультимедийный проектор, ноутбук, экран 3x4 м, доска маркерная, аудиооборудование (микрофон, колонки)
207	Auditorium for seminars, monitoring and midterm certification, group and individual consultations	Stationary multimedia projector, laptop, 3x4 m screen, interactive board.
209	Auditorium for seminars, monitoring and intermediate certification, group and individual	Stationary multimedia projector, laptop, 1x2m screen, interactive whiteboard.
209/1	Consultations	Photoelectric colorimeter, biochemical blood analyzer, glucometer, urine analyzer, lactate analyzer, water bath, thermostat, OPN-8 centrifuge, pH meter, magnetic stirrer, set of reagents and chemical glassware.
207/1	Laboratory assistant for the preparation of a laboratory workshop for the storage of laboratory equipment, reagent kits, glassware.	Distiller, refrigerator, scales, drying cabinet, fume hood, electronic laboratory CAS MWP-150, Pioneer - basic analytical balance, air conditioner, Ultrasonic cleaner.
412	Auditorium for seminars, monitoring and midterm certification, group and individual consultations	Stationary multimedia projector, laptop, 3x4 m screen, whiteboard.

1.4.7. Student research work

Doing research provides students with the opportunity to expand their knowledge and skills. In the process of scientific work and in the preparation of reports, a more intensive educational process and professional communication between teachers and students are carried out. Scientific work contributes to a deeper and more systematic assimilation of knowledge.

SRWS is carried out in two stages, for two semesters.

At the first stage, students are introduced to the basics and elements of scientific research, develop the skills of independent work in in-depth study of natural and fundamental sciences.

The forms of **SRWS** at this stage can be: abstracting of individual topics of the studied courses; compiling a bibliography on a specific topic;

- participation in the production of teaching aids (tables, layouts, models);

- production of diagrams, posters on the instructions of the department;
- participation in the preparation of a lecture demonstration, etc.

At the second stage, students are directly involved in research work. They are entrusted with specific theoretical and experimental work in the laboratory of biochemistry.

It is advisable to use the group form at the first stage of the research work to teach students the methods and skills of conducting research, as well as in cases where the work requires a large amount of work, unique equipment, etc.

The main form of performing research work is individual work on the task formulated by the leader.

It is advisable to formulate the task for the research work in such a way that it has a promising character. The scope and nature of the assignment should take into account the student's success and inclinations. The task should reflect all the work necessary to solve the task. It is advisable to attach students to a specific scientific group when performing SRWS. In this case, it is possible to develop the student's work on the same subject during practice and graduation work, ensuring the high quality of the final stages of training. Students are given individual assignments for the development of real scientific and industrial problems related to the subject of the department. The results of the development are documented in the form of a report and defended at the department. The best works are presented at scientific conferences, competitions and exhibitions.

Technology for the implementation of educational research work of students

The process under consideration consists of separate stages, each of which is a set of homogeneous stages of the technological process. A stage is a complete complex of operations, each of which, in turn, can be considered as a small complex of homogeneous actions.

Choosing a topic consists of the following three stages:

- development of topics
 - development of a research plan
 - preparation and writing of a report
- When developing a topic, a specific task is put forward in the study - to develop a progressive technology, a new product, a technological scheme of production, etc. There are a number of requirements for the topic:
 - relevance (it should be important, currently requiring permission);
 - novelty (i.e. the theme in such a setting has never been developed and is not currently being developed, thus duplication is excluded);

The choice of the topic of educational and research work of students is associated with the specifics of scientific research conducted at the department.