

**Azerbaijan Medical University
Training program
(syllabus) on the subject
Biological Chemistry-2**

**"Confirmed" by
Head of Biological Chemistry
Department,
Prof. Azizova G.I.**

SYLLABUS

ACADEMIC DAILY CALENDAR ON MEDICALBIOCHEMISTRY-2 LECTURE AND LABORATORY LESSONS. LABORATORY CLASSES, COLLOQUIUMS AND EXAM QUESTIONS

Subject code: 2406.02
Subject teaching semester: VI (Pharmaceutical faculty – 050802)
Subject credits: 3
Subject type: Compulsory
Teaching language: Azerbaijani, Russian, English
Teachers on the subject: The teaching staff of the Biological Chemistry Department

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BAKU – 2022

**The program developed by assoc. prof. Amirova M.F., senior
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of the Biological Chemistry department prof. Azizova G.I.**

Evaluation method	Score (points)
Exam (final)	50
Ongoing assessment (1st colloquium)	5
Ongoing assessment (2nd colloquium)	20
Ongoing assessment (3rd colloquium)	5
Assessment for class attendance	10
Free topics (students' project presented in a group)	10
Totally	100

Student knowledge assessment based on the sum of the cumulative grade, midterm grade and a grade received on the exam		
less than 51 points	unsatisfactory grade (failed)	F
51-60 points	marginal grade	E
61-70 points	satisfactory score	D
71-80	good score	C
81-90	very good score	B
91-100	excellent score	A

Study-load in semester			
Activity	Amount	Duration (hours)	Total working hours
Ongoing assessment (colloquium)	3	2	6
Semester exam	1	1	1
Lectures	5	2	10
Laboratory (practical exercises)	14	2	28
Self-training			45
Total working hours			90

***Thematic plan of laboratory classes on Medical biochemistry-2 for
III year students of Pharmaceutical faculty in the 2021/2022
academic year spring term***

№	Lesson's topic	Biochem.lab. manual theory & meth., 2019
1.	<i>Introduction to the dynamic biochemistry program. General rules of metabolism – 2 h.</i>	Teacher, text-book
2.	<u>General rules of metabolism.</u> General and specific stages of catabolism. I and II general pathways of catabolism. Electron transport chain –2 h. <u>Lab. work:</u> Determination of pyruvic acid in the blood. Determination of Succinate Dehydrogenase activity.	156-158
3.	<u>Carbohydrate metabolism:</u> digestion, transport of mono-saccharides through membranes. Glycogen metabolism, process regulation – 2 h. <u>Lab. work:</u> Determination of glucose in blood by glucose oxidase method.	145
4.	<u>Carbohydrate metabolism:</u> glycolysis, it's types, energetic value, regulation. Interaction gluconeogenesis-glycolysis, regulation of these processes– 2 h.	theoretical material
5.	<u>Carbohydrate metabolism disorders:</u> hereditary and acquired. Diabetes mellitus. Glycogenoses and glycosidoses– 2 h. <u>Lab. work:</u> Significance of glycosylated hemoglobin determination.	148
6.	<u>Colloquium:</u> <i>Metabolism of the major body constituents and energy. Carbohydrate metabolism. Submission of independent works– 2 h.</i>	textbook and practice book on questions
7.	<u>Protein metabolism:</u> digestion, absorption, decay of proteins. Indigestion, malabsorption syndrome– 2 h. <u>Lab. work:</u> Qualitative and quantitative analysis of gastric juice. Digestion of proteins with pepsin and trypsin.	52-57
8.	<u>Protein metabolism:</u> nitrogen balance. Sources of amino	283

	acid pool and the main ways of its usage. General ways of amino acid metabolism – 2 h . Lab. work: Diagnostic significance of ALT and AST activity determination.	
9.	<u>Protein metabolism:</u> formation, toxic effects and neutralization of ammonia. Ketogenic and glycogenic amino acids. Biosynthesis of non-essential amino acids– 2 h . Lab. work: Aminosiduria test. Determination of urea in the blood.	259
10.	<i>Mid-term assessment. Main compounds and energy metabolism, ETC. Metabolism of carbohydrates and proteins – 2 h.</i>	textbook and practice book on questions
11.	<u>Nucleoprotein metabolism</u> – 2 h . Lab. work: Determination of uric acid in the blood.	264
12.	<u>Metabolism of hemoproteins</u> – 2 h . Lab. work: Determination of hemoglobin in the blood.	67
13.	<u>Lipid metabolism:</u> digestion, absorption, resynthesis and transport to tissues. Metabolism of bile acids. Disorders of lipid digestion, intestinal absorption and transport – 2 h . Lab. work: Determination of bile acids.	87
14.	<u>Lipid metabolism: intracellular lipolysis. Types of fatty acid catabolism: α-, β- and ω-oxidation. β-oxidation of fatty acids (saturated, unsaturated and odd-chain). Energetic value of process. Glycerin metabolism – 2 h.</u>	theoretical material
15.	<u>Colloquium: Metabolism of lipids. Submission of independent works</u> – 2 h .	textbook and practice book on questions
16.	<u>Functional biochemistry of blood and liver</u> – 2 h . Lab. work: Determination of total protein in the blood.	64
17.	<u>Functional biochemistry of kidneys, metabolism of drugs</u> – 2 h . Lab. work: Analysis of normal and pathological urine.	230-244
18.	<i>The final lesson. Assessment of the learning mastery on the basis of situational tasks and tests. Submission of independent works – 1h.</i>	textbook and practice book on questions

Totally: 35 hours

***Thematic plan of lectures on Medical biochemistry-2 for
III year students of Pharmaceutical faculty in the spring semester
of 2021/2022 academic year***

№	Lecture's topic	Hours
1.	The general principles of main body compounds and energy metabolism. General pathways of catabolism, their energetic significance. The biological oxidation, types. ATP synthesis ways. Carbohydrate metabolism: digestion, absorption. Glycolysis and gluconeogenesis, the relationship and biochemical features of these processes.	2
2.	Glycogen metabolism. Pentose phosphate pathway of glucose breakdown. Mechanisms for blood sugar control; hypo- and hyperglycemia. Diabetes mellitus. Inherited and acquired disorders of carbohydrate metabolism.	2
3.	Significance of dietary proteins: their biological value, digestion, absorption. General pathways of amino acid metabolism in tissues. Formation of ammonia, its impact on the body and ways of neutralization. Inherited and acquired disorders of amino acid metabolism.	
4.	Lipid metabolism: digestion, absorption, re-synthesis in the intestine. Energetic value of the process of β -oxidation of fatty acids. Ways of acetyl-CoA usage: metabolism of ketone bodies, biosynthesis of fatty acids. Features of cholesterol metabolism, its stages; derivatives of cholesterol. Atherosclerosis, gallstone disease. Obesity. Liver fatty dystrophy.	2
5.	Blood biochemistry: composition of blood, biosynthesis and breakdown of hemoglobin. Jaundice. Stages of toxins detoxification in the liver.	2

Totally: 10 hours

COLLOQUIUM QUESTIONS ON MEDICAL BIOCHEMISTRY-2

Metabolism of the major body constituents and energy. Biological oxidation. The general stages of catabolism. Carbohydrate metabolism

1. General rules of metabolism. Specific and general pathways of catabolism of main nutrients.
2. The first general pathway of catabolism and its energetic value (schedule).
3. Second general pathway of catabolism: sequential reactions, main substrates and energetic value.
4. Biological oxidation and tissue respiration. Oxidase reactions (for energy production), enzymes involved in process. Function of electron transfer chain, its structure, sequential localization of its components according to their redox potential. Transfer of electrons and protons to oxygen (schedule).
5. Oxidative phosphorylation. P/O coefficient. Modern theory of oxidative phosphorylation mechanism (Mitchell's theory). Mechanism of proton potential formation in the mitochondrial inner membrane, H^+ -ATP-synthase and ADP-ATP-translocase, their structure, localization and functions. Uncouplers of oxidative phosphorylation.
6. Oxygenase reactions. Mono- and dioxygenases. Microsomal oxidation, microsomal chain, its components, significance.
7. Active oxygen species (superoxide anion, hydroxyl radical, singlet oxygen). Prooxidants. Antioxidants. Protection of the organism from the oxygen active species toxic effects.
8. Carbohydrates digestion: dietary carbohydrates, and saliva, pancreas and intestinal juice amylolytic enzymes that digest them.
9. Transport of monosaccharides across the membranes, their absorption and transformation in the tissues.
10. Glycogen metabolism. Regulation of glycogenesis and glycogenolysis.

11. Sequential reactions of the glycolysis and its biological significance. Glycolysis oxidation-reduction reaction.
12. Aerobic breakdown of carbohydrates, bioenergetic value.
13. Gluconeogenesis (schedule). Substrates of the process. Cori cycle.
14. Sequential reactions of pentose phosphate pathway (apotoxic oxidation) of carbohydrates and biological significance of this process.
15. Regulation of carbohydrate metabolism. Hyper- and hypoglycemia, glucosuria.
16. Diabetes mellitus: causes, manifestations, biochemical mechanism in the development of complications.

Metabolism of proteins and nucleic acids

1. Nutritional requirements of dietary proteins. Nitrogen balance. Sources and fate of amino acid pool. Proteinases that break down tissue proteins.
2. Digestion of proteins in the stomach. Gastric juice composition: hydrochloric acid, pepsin, gastrin. Analysis of normal and pathological gastric juice (lab. work)
3. Digestion of proteins in the small intestine. Pancreatic juice composition, its proteolytic enzymes - trypsin, chymotrypsin, elastase, carboxypeptidase. Proteases of intestinal juice. Disorders of protein digestion and intestinal absorption of amino acids. Malabsorption syndrome.
4. Decay of proteins in the large intestine and neutralization of products of putrefaction. PAPS and UDPGA.
5. Deamination of amino acids. Mechanism of oxidative deamination.
6. Transamination of amino acids, diagnostic value of serum-transaminase activity determination. Transdeamination.
7. Decarboxylation of amino acids and neutralization of the obtained products.
8. Ways of ammonia formation, its toxic effect and neutralization. Synthesis of urea and other ways of neutralizing ammonia.
9. The fate of nitrogen-free hydrocarbon residues of amino acids. Glucogenic and ketogenic amino acids. Biosynthesis of non-essential

amino acids.

10. Specific pathways of phenylalanine and tyrosine amino acid's metabolism and disorders.
11. Specific pathways of proline and hydroxyproline amino acid's metabolism and disorders.
12. Catabolism of purine nucleotides in the tissues.
13. Catabolism of pyrimidine nucleotides.
14. Disorders of purine and pyrimidine nucleotide metabolism (gout, xanthinuria, Les-Nyhan syndrome, orotaciduria).

Lipid metabolism

1. Digestion of lipids:). Bile acids, their types and significance in digestion.
2. The breakdown of fats (triacylglycerols) and phospholipids in the gastrointestinal tract (GIT). Lipases and phospholipases.
3. Absorption of lipid hydrolysis products. Lipids re-synthesis in the enterocytes and transport to tissues.
4. Intracellular lipolysis. Fatty acids β -oxidation, reactions and energetic value.
5. Biosynthesis of fatty acids, regulation of process and its energy sources.
6. Synthesis of ketone bodies (ketogenesis). Breakdown of ketone bodies (ketolysis). Ketonemia and ketonuria, causes.
7. Biosynthesis of triacylglycerols and phospholipids. Lipotropic factors.
8. Synthesis of cholesterol. Diagnostic significance of blood cholesterol levels and disorders.
9. Neuro-endocrine regulation of lipid metabolism.
10. Liver fatty infiltration and fatty liver dystrophy.

FUNCTIONAL BIOCHEMISTRY

Functional biochemistry of blood

1. Blood functions. Metabolic features of blood cells (red blood cells, leukocytes, platelets). Synthesis of hemoglobin. Porphyria types.
2. Blood biochemical composition. Plasma and serum proteins. Blood serum enzymes.
3. Non-protein nitrogenous compounds of blood: residual nitrogen. Azotemia, its types.
4. Nitrogen-free organic and inorganic compounds in blood plasma. Trace elements.
5. Acid-base balance of blood. Blood buffer systems. Acidosis, alkalosis.
6. Respiratory function of blood, effect of external (environmental) and internal factors.
7. Blood clotting. Coagulation factors. Clot formation mechanism.
8. Anticoagulant system of blood. Inhibitors of blood clotting enzymes and anticoagulant system. Fibrinolysis.

Functional biochemistry of the liver

1. Liver role in carbohydrate metabolism.
2. The role of liver in lipid metabolism. Bile composition, general characteristics and significance.
3. Liver role in protein metabolism.
4. Stages of detoxification in the liver. Breakdown of hemoglobin: bile pigments, their formation, neutralization and excretion. Jaundice, its types.

Functional biochemistry of the kidney

1. Features of metabolism in the kidneys.
2. The role of the kidneys in the body acid-base balance regulation.
3. General properties of urine (in norm and pathology).
4. Normal chemical compounds of urine. Diagnostic significance of creatinine determination in urine.
5. Pathological compounds of urine. Kidney stone disease.

Functional biochemistry of the nervous system

1. Lipids, proteins and carbohydrates of nerve tissue and their metabolism.
2. The role of mediators in the transmission of nerve impulses. Cholinergic and adrenergic receptors.

Functional biochemistry of drugs

1. Metabolic features of drugs.
2. The biochemical mechanism of metabolic stages of xenobiotics. Catalysis with oxydoreductases and hydrolases.
3. Alkylation, acetylation reactions. Reactions with participation of tyosulphate, glucuronic and sulphuric acids.
4. Inactivation, activation, detoxification, toxification.
5. Determination of salycilic acid and morphine.
6. The factors which can influence on drug's metabolism.
7. The absorption and excretion of drugs.
8. Specific and non-specific blood systems for drugs transporting.

LABORATORY TRAINING QUESTIONS ON MEDICAL BIOCHEMISTRY-2

LESSON II – General laws of metabolism. Specific and general pathways of catabolism. I and II general pathways of catabolism, ETC

1. Metabolism: definition, types according to living organisms, the difference and relationship between catabolism and anabolism.
2. Metabolic pathway types, their regulation.
3. Main stages of catabolism and energy formation (scheme explanation): specific and general pathways.
4. The first general pathway of catabolism. Pyruvate dehydrogenase complex, energetic value of process. Determination of pyruvic acid in the blood (lab. work).
5. Second general pathway of catabolism: write and explain scheme.

6. Reactions that provide energy in the citric acid cycle, the enzymes involved. Principle of succinate dehydrogenase determination in muscle (lab. work).

***LESSON III –Carbohydrate metabolism: digestion,
transport of monosaccharides across cellmembranes.
Glycogen metabolism, its regulation***

1. Carbohydrate metabolism-significance for the human body.
2. Digestion of carbohydrates in the oral cavity and intestine. Amyolytic enzymes of the pancreas and intestinal juice. Amylase types.
3. Different ways of monosaccharide transport across membranes. GLUTtypes.
4. Normoglycemia, glucose levels change. Estimation of blood glucose by glucose oxidase method.
5. Glycogen synthesis (scheme), enzymes involved.
6. Glycogen breakdown (scheme). Phosphorylase activation.
7. Regulation of glycogen metabolism.

***LESSON IV – Carbohydrate metabolism: glycolysis, its types,
regulationand energetic value (ATPs produced).
Glycolysis- gluconeogenesis interaction***

1. Glycolysis. Preparatory stage reactions, enzymes involved. Isoenzymes of hexokinase, their role in metabolism. Significance of the process.
2. Redox (oxidation-reduction) reactionin of glycolysis (scheme), enzymes involved, energetic value (ATP produced).
3. Aerobic glycolysis (scheme), its steps, energetic value (ATP produced).
4. Entry of fructose and galactose into glycolysis.
5. Shuttle mechanisms: malate-aspartate, lactate, glycerolphosphate shunt mechanisms.
6. Gluconeogenesis scheme, its substrates and 3 by-pass(irreversible) stages.
7. Gluconeogenesis-glycolysis interaction: Cori cycle.

8. Regulation of glycolysis and gluconeogenesis.

***LESSON V – Carbohydrate metabolism disorders:
inherited and acquired. Diabetes mellitus. Glycogenoses
and mucopolysaccharidoses***

1. Hereditary disorders of carbohydrate metabolism: inherited disorders of fructose and galactose metabolism.
2. Acquired disorders of carbohydrate metabolism.
3. Diabetes mellitus: types, manifestations and biochemical mechanism in the complications development.
4. Significance of blood glycosylated hemoglobin determining (lab. work).
5. Glycogenoses, types, manifestations.
6. Mucopolysaccharidoses.

***LESSON VII – Protein metabolism: digestion, absorption
of proteins, decay. Indigestion, malabsorption syndrome***

1. Significance of protein metabolism in the human body.
2. Digestion of proteins in the stomach: gastric juice enzymes, their activation and specificity. Digestion of proteins by pepsin (lab. work).
3. Normal gastric juice composition. HCl formation mechanism, its role in digestion. Qualitative and quantitative determination of HCl (lab. work).
4. Total acidity of gastric juice and its changes in various diseases.
5. Analysis of gastric juice (by Michaelis method): determining of total acidity and free HCl (lab. work).
6. Diagnostic value of gastric juice pathological components (such as blood and lactic acid) assay (lab. work).
7. Pancreatic juice proteolytic enzymes: activation and action mechanism of trypsinogen and other endopeptidases. Digestion of proteins by trypsin (lab. work).
8. Exopeptidases of the pancreas and intestinal juice, their action.
9. Amino acids absorption in intestine.

10. Significance of protein decay of in the large intestine.
11. Formation and neutralization of toxic substances (poisons: cresol, phenol, skatol, indole, etc.). PAPS and UDPGA.
12. Disorders of protein digestion and intestinal absorption of amino acids. Malabsorption syndrome.

LESSON VIII – Protein metabolism: nitrogen balance.

The main sources and waysof amino acids using.

General ways of amino acid metabolism

1. Indicator that determine the protein metabolism status: nitrogen balance, its types.
2. The main sources and ways of amino acid using in the cell.
3. General ways of amino acid metabolism. Deamination types, biochemical mechanism of process.
4. Transamination. Enzymes and coenzymes involved in the process. Transdeamination.
5. Clinical significance of determining the transaminases activity in the blood. The principle of determining the activity of ALT and AST in the blood (lab. work).
6. Decarboxylation. Formation and neutralization of biogenic amines.

LESSON IX – Protein metabolism: formation of ammonia, ammonia toxic effect and neutralization. Ketogenic and glucogenic amino acids. Biosynthesis of non-essential amino acids

1. Ways of ammonia formation in tissues. Ammonia toxicity.
2. Rapid temporary neutralization of ammonia: synthesis of glutamine, asparagine and alanine. Reductive amination
3. Ultimate neutralization of ammonia: formation of urea in the ornithic cycle; intermediate stages and enzymes involved in this process. Ammonium salts formation.
4. Urea level in the blood, its variations in norm and pathological conditions. The principle of urea estimation in the blood by diacetylmonoxime assay (lab. work).

5. The fate of nitrogen-free amino acid carbon skeletons: glycogenic and ketogenic amino acids. Biosynthesis of non-essential amino acids.

LESSON XI – Nucleoprotein metabolism.

1. Digestion of nucleic acids in the gastrointestinal tract, the fate of digestion products.
2. Decomposition of purine nucleotides (scheme).
3. Determination and diagnostic value of uric acid level estimation in blood serum (principle of lab. work). Gout.
4. Synthesis of purine nucleotides (scheme).
5. Orotaciduria.

LESSON XII – Hemoproteins metabolism.

1. Digestion of chromoproteins in the gastrointestinal tract.
2. Iron metabolism in the body.
3. Estimation of hemoglobin level in the blood (lab).
4. Degradation of hemoglobin in tissues: formation of bile pigments (bilirubin and biliverdin). Properties of free (indirect) bilirubin and its determination (lab. work).
5. Jaundice types and importance of bilirubin fractions determination for jaundice diagnosis. Total bilirubin level in the blood serum, and its determination by Jendrassik and Cleghorn assay method (lab. work).

LESSON XIII – Lipid metabolism: digestion, absorption, resynthesis and transport to tissues. Metabolism of bile acids. Disorders of lipid digestion, intestinal absorption and transport

1. The importance of lipid metabolism for the human body.
2. Enzymes involved in the digestion of lipids in the gastrointestinal tract, their specificity.
3. Synthesis of bile acids, regulation of process. The role of bile acids in the digestion of lipids. Qualitative determination of bile acids

(lab. work).

4. Absorption of lipid breakdown products in the intestine and re-synthesis of lipids in enterocytes.
5. Biosynthesis (re-synthesis) of triacylglycerols: activation of substrates, enzymes involved in the process (scheme).
6. Transport of dietary lipids to tissues. Chylomicrons. Lipoprotein lipase. Hyperlipemia.
7. Disorders of lipid digestion, intestinal absorption and transport to tissues.

LESSON XIV – Lipid metabolism: intracellular lipolysis.

Types of fatty acids catabolism: α -, β - and ω -oxidation.

β -oxidation of saturated, unsaturated and monounsaturated fatty acids, energetic value of process (ATPs produced).

Glycerin metabolism

1. Intracellular lipolysis. Regulation of lipid mobilization in adipose tissue.
2. Catabolism of glycerin, energetic value of process (ATPs produced).
3. Types of fatty acids catabolism: β -oxidation of fatty acids (scheme), its energetic significance, and regulation.
4. Types of fatty acids catabolism: α - and ω -oxidation.
5. β -oxidation of fatty acids with an odd carbon chain, importance of process.

LESSON XVI –Functional biochemistry of blood and liver

1. Blood plasma proteins: albumins, globulins, fibrinogen, their characteristics; pathological conditions associated with their levels variation. The principle of biuret method (lab work).
2. Some clinically important blood plasma proteins: enzymes, transferrin, ceruloplasmin, haptoglobin, properdin, interferon, C-reactive protein.
3. Small-weight nitrogenous and nitrogen-free compounds of blood serum. Azotemia types.

4. Blood clotting factors.
5. Liver role in carbohydrate metabolism.
6. Liver role in lipid metabolism.
7. Liver role in protein and amino acid metabolism.
8. Detoxification function of the liver

LESSON XVII –Functional biochemistry of kidneys and drugs.

1. Normal diuresis. The color of urine. Compounds that color normal urine. Turbidity of urine. Identification the causes of turbidity.
2. Urine pH, its determination (lab. work). Specific gravity of urine, its determination and change in pathological conditions (lab. work).
3. Organic and inorganic compounds of urine. Determination of vitamin C in urine (lab. work).
4. Pathological compounds of urine. Ketonuria, causes. Determination of ketone bodies in urine (lab. work).
5. Hematuria, causes. Determination of blood pigments in urine (lab. work).
6. Glucosuria, causes. Qualitative and quantitative determination of sugar in the urine. Quantitative analysis of sugar in urine by titration (lab. work).
7. Proteinuria, causes. Analysis of protein in urine. Determination of urinary protein by Roberts-Stolnikov method (lab. work).
8. Metabolism of xenobiotics in human body.

COLLOQUIUMS PROCEDURES

RULES FOR CONDUCTING COLLOQUIUMS

The purpose of the training is to reveal the degree of students assessment by individual survey.

The teacher calls the 4 student to answer. The sheet contains the date of the month, the surname of the student and 2 questions.

If the question consists a structure, scheme, and the student cannot write them, and answers just orally, then the maximum point should be

essed as 1. You do not need to write the text of the answer. The answer to each question is estimated at 2.5 points.

When students answer questions, first of all should be paid attention to what extent they master the important questions of their section.

PRESENTATION TOPICS ON MEDICAL BIOCHEMISTRY-2

1. Chemical composition of muscle tissue: muscle proteins, nitrogenous extractives. Nitrogen-free compounds.
2. Heart and smooth muscle main characteristics and chemical composition. Energy supply of muscle tissue. Biochemical mechanism of muscle contraction.
3. Functions of connective tissue, main cells and proteins of the intercellular matrix, non-collagen proteins. Adhesive and anti-adhesive proteins. Glucosaminoglycans and proteoglycans.
4. Chemical composition of blood plasma. Plasma proteins, their fractions and biological role. Blood serum enzymes and their clinical significance.
5. Small-weight nitrogenous and nitrogen-free compounds of blood serum. Macro- and microelements of blood. Acid-base balance of blood. Blood buffer systems.
6. Liver role in metabolism as a key metabolic organ.
7. Metabolic features of ethyl alcohol in the human body.
8. Metabolic syndrome as the leading modern pathology.
9. Anemia, its types, biochemical base of development.
10. Metabolism of drugs.
11. Kidneys role in water-salt metabolism.
12. Kidneys role in regulation of acid-base balance.
13. Urine formation mechanism. Regulation of renal function.
14. Biochemistry of bone tissue.
15. Factors affecting bone and connective metabolism tissue.
16. Characteristics of the biochemistry of nerve tissue.
17. Neurotransmitters: types and mechanism of action.
18. Antitoxic function of the liver.

19. Blood coagulation factors and anticoagulation system.
20. Covid-19 virus impact on biochemical processes.
21. Impact of environmental factors on biochemical processes (global warming). Oxidative stress and antioxidant system.

References

1. Azizova G.İ., Dadashova A.R., Amirova M.F., Vahabova G.R., Biochemistry laboratory manual theory and methods. Baku, 2019, p. 287.
2. Richard A.Harvey, Denise R.Ferrier. Lippincott's illustrated reviews. Biochemistry. 6th edition.
3. David L.Nelson, Michael M.Cox. Lehninger Principles of biochemistry. 5th edition.
4. Islamzade F.I., Efendiyev AM, Islamzade F.Q. Basics of human biochemistry (textbook, Volume I). Baku, 2015.
5. Islamzade F.I., Islamzade F.Q., Efendiyev A.M. Basics of human biochemistry (textbook, Volume II). Baku, 2015.
6. Efendiyev A.M., Islamzade F.Q., Garayev A.N., Eyyubova A.A. "Laboratory classes on biological chemistry" (textbook). Baku, 2015.
7. Efendiyev A.M., Eyyubova A.A., Garayev A.N. "Pathological and clinical biochemistry" (textbook). Baku, 2019.
8. Qarayev A.N. Biological chemistry (Basics for preparing for magistracy). 2018.
9. Lecture material.