

Azerbaijan Medical University
Department of Biological
Chemistry
Training program on the subject
“Biological Chemistry”
(syllabus)

"I CONFIRM"
Head of the Biological
Chemistry Department
prof. Azizova G.I.

SYLLABUS

LECTURES AND LABORATORY CLASSES ON STATIC BIOCHEMISTRY. CALENDAR-TOPIC PLANS. QUESTIONS FOR CLASSES, COLLOQUIUMS AND EXAMS PREPARING. PRESENTATION TOPICS ON STATIC BIOCHEMISTRY

Subjectcode:	2406.02
Typeofsubject:	Obligatory
Subjectteachingterm:	III (General-medicine faculty)
Subjectcredits:	4
Form of teaching the subject:	full-time
Language of teaching:	Azerbaijani, russian, English
Teachers teaching the subject:	The teaching staff of the Department of Biological Chemistry

Contact number of the department:	(012) 440 80 77
E.mail:	biochemistry@amu.edu.az

Programme is prepared by Employees of the Biological Chemistry Department – assoc. prof. Amirova M.F., assoc. prof. Vahabova G.R., ass. Dashdamirova G.S. (with general editing by the head of the department, prof. G.I.Azizova).

Calendar-thematic plan on static biochemistry laboratory classes for students of II course in General Medicine Faculty autumn term of 2021/2022 academic year

№	Topics of the lessons	Biochemistry laboratory manual theory and methods, 2019
1.	<i>Acquaintance with the group, internal discipline and technical safety rules. Chemical composition of the organism. Amino acids – 2 h.</i>	
2.	<i>Structure, classification, physico-chemical properties of amino acids. Peptide bond – 2 s.</i> Lab. work: Color reactions on amino acids and proteins.	16-22
3.	<i>Structure, physico-chemical properties of proteins – 2 h.</i> Lab. work: Protein sedimentation reactions. Determination of the isoelectric point of proteins.	5-11
4.	<i>Simple proteins. Biologically active natural peptides – 2 h.</i> Lab. work: Quantitative determination of blood serum total protein by biuret method. Determination of albumin in the blood serum.	164?244
5.	<i>Complex proteins. Phospho-, glyco-, lipo-, metalloproteins – 2 h.</i> Lab. work: Reactions on phospho- and glycoproteins.	34-35
6.	<i>Chromoproteins. Structural features of hemoglobin – 2 h.</i> Lab. work: Reactions on hemoglobin.	37-39
7.	<i>Nucleoproteins. Structural properties of nucleic acids. Matrix biosynthesis – 2 h.</i> Lab. work: Hydrolysis of nucleoproteins.	43-44
8.	Colloquium: Amino acids and proteins – 2 h. Acceptance of independent study presentations.	
9.	<i>Structure and properties of enzymes. Coenzymes – 2 h.</i> Lab. work: Termolability, specificity of enzymes and the effect of optimum pH on the activity of enzymes.	70-74
10.	<i>Mechanism of enzymatic action. Determination of enzyme activity. Classification of enzymes – 2 h.</i> <i>Acceptance of independent study presentations.</i>	

11.	<i>Activators and inhibitors of enzymes. Regulation of enzymatic activity – 2 h.</i> <u>Lab. work:</u> The effect of activators and inhibitors on amylase activity. Inactivation of the enzyme cholinesterase with proserin.	76-77
12.	<i>Vitamins: classification, vitamin disbalances. Antivitamins. Fat-soluble vitamins – 2h.</i>	
13.	<i>Water-soluble vitamins. Vitaminotherapy - 2 s.</i> <u>Lab. work:</u> Reactions on vitamins B ₁ , B ₂ , PP, B ₆ and C.	86-96
14.	<i>Acceptance of independent study presentations – 2 h.</i>	
15.	<i>Structural features and biochemical properties of hormones, Classification, synthesis and regulation of hormones – 2 h.</i>	
16.	<i>Mechanism of hormones action. Intracellular receptors of hormones – 2 h.</i>	
17.	<i>Biochemical properties of some hormones: their structure, secretion and biological action; hypo- and hypersecretion of hormones – 2 h.</i> <u>Lab. work:</u> Reactions on adrenaline, insulin and thyroxine.	105,108, 110-111
18.	<i>Biochemical characteristics of carbohydrates – 2 h.</i> <u>Lab. work:</u> Reactions on carbohydrates.	46-56
19.	<i>Preparation for med.-term assessment with situational tasks and tests – 2 h.</i>	
20.	<i>Med.-term assessment (amino acids, proteins, enzymes, vitamins) – 2 s.</i>	
21.	<i>Chemistry of lipids – 2 h.</i> <u>Lab. work:</u> Emulsification of fats. Determination of fatty acids. Qualitative reactions on cholesterol.	57, 59, 66-67
22.	<i>Colloquium: Biochemical properties of hormones – 2 h.</i>	

Totally: 44 hours.

**Calendar-thematic planonstatic biochemistry lectures in
General Medicine Faculty for II course students.
Autumn term of 2021/2022 academic year**

№	Subject of lecture	Hours
1.	Biochemistry subject, its goals, objectives and role in medicine. Physico-chemical properties and structural features of proteins. Aminoacids.	2
2.	Simple and complex proteins. Hemoglobin, its heterogeneity and cooperativeness. Immunoglobulins.	2
3.	Biochemical properties of nucleic acids. Matrix biosynthesis process.	2
4.	Enzymes, their classification, and mechanism of action: coenzymes. Enzymology.	2
5.	Vitamins, their classification and mechanism of action. Structure and biochemical properties of water-soluble vitamins.	2
6.	Fat-soluble vitamins. Vitaminotherapy.	2
7.	Hormones: their classification and biochemical properties. Mechanism of some hormones synthesis. Hormones secretion and transmission of hormonal signal.	2
8.	Metabolism of some hormones. Metabolic changes during hypo- and hypersecretion of hormones. Importance of hormones in the diagnosis.	2
9.	Chemistry of carbohydrates. Clinical importance of heteropolysaccharides.	2
10.	Chemistry of lipids.	2

Totally: 20 hours.

COLLOQUIUM QUESTIONS

***Biochemical properties of amino acids, proteins
and nucleic acids. Matrix biosynthesis***

1. Classification of amino acids based on different principles (depending on side chain structure, charge of radical, radical polarity, the number of amino- and carboxylic groups, nutritional requirements).
2. Proteinogenic and non-proteinogenic amino acids' structure (with examples), their general characteristics and role in metabolism.
3. Physico-chemical characteristics of amino acids: stereoisomerism, optical activity, electric charge of amino acids depending on the pH of the medium, solubility and dissociation ability of amino acids, their value for organism, titration curves, isoelectric point and their importance for human body.
4. Chemical composition of proteins, their distribution in organism, representatives, differed by their functions. Obtaining from biological materials (homogenization, extraction, fractionation), salting out and impact of this process on ionization stage of the solution. Hofmeister series. Chromatography, electrophoresis, their types and principles of techniques.
5. Physico-chemical properties of proteins: shapes, solubility, optical activity, amphotericity, isoelectric point. Denaturation, features of denaturing factors' action, renaturation. Protein sedimentation factors, use these reactions in methods of protein's features investigation.
6. Different types of protein classification. Fibrous proteins' structural features and functions. Collagen: amino acid composition; structure of collagen's protomer – tropocollagen and molecule-stabilizing bonds. Keratin: occurrence in the human body, α - and β -keratins, their amino acids composition.
7. Proteins' structural organization levels, their features. Primary structure and peptide bond. Methods of amino acids determination in the protein molecule: hydrolysis (types and their limitations). Determination of N- and C-terminal amino acids and disulfide bonds in the polypeptide chain. Common and specific color reactions for proteins and amino acids, their principles and value.
8. Spatial configuration of proteins: bonds stabilizing secondary, tertiary and quaternary structure of protein. Protein domain concept. Folding of proteins molecules. The concept of chaperones.

9. Natural peptides: their classification, representatives according to the origin, and specific ways of action. Angiotensin and kinins, their precursors, scheme of formation and enzymes involving in this process. Glutathion, carnosine, anserine – their structure, value, occurrence.
10. Simple proteins, principle of their classification. Albumines and globulines; prolamines and glutelins, protamines and histones. Human blood protein fractions (proteinogram), and its changes in the pathology.
11. Metalloproteins, their representatives, occurrence, value; linkage types, formed between metals and the peptide chain. Metalloid proteins.
12. Phosphoproteins: representatives, occurrence, types of linkage between prosthetic group and protein part. Significance of proteins phosphorylation and dephosphorylation.
13. Glycoproteins and proteoglycans: representatives, biological role, occurrence, composition and the percentage of carbohydrate component (examples). Bonds for linkage between carbohydrate component and the protein moiety. Diagnostic value of sialic acid determination by Hess method.
14. Lipoproteins and proteolipids: physico-chemical properties, occurrence, localization in organism, bonds involved in protein-lipid interactions, types of apo-proteins. Blood plasma lipoprotein fractions, their structural features and functions.
15. Chromoproteins: classification, representatives. Flavoproteins, hemoproteins: occurrence, role in metabolism. Structure of heme.
16. Structural features of hemoglobin: heterogeneity, chemical properties, effect of cooperativeness, Bohr effect, allosteric regulators. The methods of scarce blood detection in biological materials.
17. Different forms of hemoglobin: oxyhemoglobin, carbhemoglobin, met-hemoglobin, and carboxyhemoglobin – their structure and functional features, the significance of blood saturation with oxygen. Hemoglobinoses and hemoglobinopathies.
18. Myoglobin and other representatives of hemoproteins (catalase, peroxidase, cytochromes), their structural and functional features.

19. General characteristics of nucleic acids. Purine and pyrimidine bases: lactam and lactim forms, nucleic acid minor forms and nitrogen bases that are not included in the nucleic acids composition. Nucleoside and nucleotide structures, their syn- and anti-configurations.
20. Primary, secondary and tertiary structure of DNA. Chargaff rules. Formation of nucleosome and chromatin.
21. The main structural features of different types of RNA. Formation of secondary and tertiary structure of RNA.
22. The role of transcription in the biosynthesis of proteins. The concept of amino acid codons.
23. Recognition of amino acids. Translation, its stages.
24. Regulation of protein biosynthesis, the effect of inducers and inhibitors on protein biosynthesis.
25. Post-translational modification of proteins.

Biochemical characteristics of enzymes and vitamins

1. Chemical nature of enzymes, their difference from inorganic catalysts. Ribozyme. Simple and complex enzymes.
2. The main properties of enzymes: their specificity types, thermolability, the impact of pH of medium on the enzymes activity.
3. Mechanism of enzymatic action. Organization of active center. Activation energy, Michaelis-Menten kinetics. Koshland theory as an induced-fit model; the concept of orientation and deformation in enzymatic action. Catalysis types: acid-base, electrophilic, nucleophilic, covalent.
4. The impact of substrate and enzyme concentration on the reaction rate. Michaelis coefficient: the relation between the substrate concentration and reaction rate.
5. Classification of coenzymes. Vitamin- and non-vitamin coenzymes: nucleotide coenzymes, metallo-porphyrins, prosthetic groups of metallo-enzymes; phosphorous esters of monosaccharides and glutathione as coenzymes, their biological role.
6. Polyenzyme systems: 3 types of their organization (give an example). Localization of enzymes in cells, organelles, organs and tissues. Isoenzymes: clinical significance, enzyme-diagnostics.

7. Activators of enzymes. Activators affecting the active center: cofactors, substrates, metal ions. Activators, that affect off-center sites. Activation of proenzymes by partial proteolysis. Enzyme activation by enzyme sulfhydryl groups reduction and dissociation of inactive enzyme complexes.
8. The two main ways of enzyme inhibition (reversible and irreversible). Inhibitor types: competitive, non-competitive and uncompetitive (give example), difference in their impact on the enzyme activity. Reactivators (give example).
9. The ways of enzymes intracellular regulation: quantitative change via induction or repression, compartmentalisation, shuttle mechanisms; the principle of feedback (retro-inhibition), conversion of proenzymes into active enzymes, chemical modification of enzymes, allosteric regulation.
10. Enzymes nomenclature and classification; six main classes of enzymes, their subclasses; enzyme code.
11. Enzymes usage in medicine: "immobilized enzymes", enzyme-pathology, enzyme-therapy and enzyme-diagnostics.
12. Vitamin A, its chemical and biological names, structure, vitamers, provitamins, biochemical functions, hypo- and hypervitaminosis, natural sources.
13. Vitamin D, its chemical and biological names, structure. Metabolism of vitamin D, its conversion into hydroxylated active derivatives and their biochemical functions; avitaminosis, hypervitaminosis, natural sources.
14. Vitamin E, its chemical and biological names, vitamers, metabolism, antioxidant activity, avitaminosis, natural sources.
15. Vitamin K, its chemical and biological names, vitamers, metabolism, biochemical functions, imbalance, natural sources.
16. Vitamin B₁, its chemical and biological names, structural features, metabolism; Coenzymes structural features (co-carboxylase). Role of vitamin B₁ in metabolism, avitaminosis, natural sources.
17. Vitamin B₂, its chemical and biological names, structural features, metabolism, coenzyme forms (FMN and FAD), their synthesis, structure. Biochemical function of vitamin B₂, avitaminosis, natural sources.

18. Pantothenic acid, its chemical and biological names, structural features, metabolism, coenzyme forms, biochemical functions, deficiency, natural sources.
19. Vitamin PP (nicotinic acid), its chemical and biological names, structure, metabolism. Coenzymes NAD^+ and NADP^+ , their biosynthesis, structure, biochemical functions, deficiency, natural sources.
20. Vitamin B₆, its chemical and biological names, vitamers, their structure, metabolism. Coenzymes PALP and PAMP, their structure, biochemical functions, avitaminosis, natural sources.
21. Folic acid, its chemical and biological names, structural features, metabolism, coenzyme forms and biochemical functions, cause of deficiency and its manifestations, natural sources.
22. Vitamin B₁₂, its chemical and biological names, chemical nature, metabolism, coenzymes, biochemical functions, causes and manifestations of deficiency, natural sources.
23. Vitamin H (biotin), its chemical and biological names, structure, metabolism, biochemical functions, deficiency, natural sources. Avidin.
24. Vitamin C, its chemical and biological names, structure, metabolism, biochemical functions, avitaminosis, natural sources.
25. Vitamin-like substances: vitamins P, B₁₅, U and F, carnitine: chemical names and chemical nature, metabolism, biochemical functions, avitaminosis, natural sources.
26. Inositol, lipoic, orotic and paraaminbenzoic (PABA) acids, choline, ubiquinone: their structures, metabolism, biochemical functions, natural sources.
27. Vitamin therapy in treatment of various diseases; use of vitamins-, coenzymes- and antivitamins – based drugs in medicine.

Biochemical characteristics of hormones

1. Characteristics of hormones: general concept, nomenclature, types according to classification.
2. Regulation mechanism of hormone synthesis and secretion: feedback principle, synergism, antagonism, permissiveness.

3. Transmission of hormonal signals through protein-receptors. Differences in hormonal effect based on receptor localization. G-proteins and secondary messengers. Hormones action mechanism: adenylate cyclase, guanylate cyclase, calcium polyphospho-inositol systems.
4. Hormones with intracellular mechanism of action. Intracellular and intranuclear receptors. The role of hormones in the regulation of the transcription.
5. Hormones synthesis, secretion, circulation, metabolism and excretion.
6. Hormones of the hypothalamus: somatoliberin, corticoliberin, thyroliberin, prolactoliberin, gonadoliberins (luliberin and folliberin), melanoliberin, melanostatin, somatostatin and prolactostatin; their chemical nature, effects and violation of secretion.
7. Hormones of the adenohipophysis: somatotropin (growth hormone), prolactin, their chemical nature and effects. Diseases associated with the pituitary gland endocrine function disorders: pan-hypopituitarism, hyper- and hyposecretion of somatotropin.
8. Hormones of the pituitary gland: thyrotropin and gonadotropins. POMC derivatives: adrenocorticotropin, lipotropic and melanocyte-stimulating hormones: their chemical nature, biochemical effects, hyper- and hyposecretions.
9. Hormones of neurohypophysis: oxytocin and vasopressin, their chemical nature, biological effects. Violation of vasopressin and oxytocin secretion.
10. Hormones of the pineal gland: melatonin, serotonin and adreno-glomerulotropin, their structure, biological effects. Diseases associated with disorders of these hormones. Biologically active substances synthesized in thymus.
11. Thyroid hormones: their structure, biological effects, metabolism. Iodine intake. Disorders of thyroid hormone secretion.
12. Hormones affecting calcium metabolism: parathormone, calcitonin, calcitriol, their chemical nature, biological effects, violation of secretion resulting in fibrous osteochondro-dystrophy, tetany and spasmophilia.
13. Pancreatic hormones. Insulin: chemical nature, regulation of secretion, influence on carbohydrate, protein, lipid metabolism. Violation

of insulin secretion, causes of diabetes mellitus, metabolic changes in this disease.

14. Glucagon, somatostatin and pancreatic peptide, their chemical nature and biological effects.
15. Hormones of the adrenal medulla, catecholamines: dopamine, adrenaline, noradrenaline and isopropyl adrenaline, their structure. Synthesis of adrenaline, its biological effects depending on receptor types. The main ways of catecholamine catabolism.
16. Hormones of the adrenal cortex: their different groups. Glucocorticoids: representatives, structure, regulation of secretion and biological role. Diseases associated with hyper- and hyposecretion of glucocorticoids (Itsenko-Cushing's disease, Cushing's syndrome, steroid diabetes, Addison's disease and Addison's syndrome).
17. Mineralocorticoids: representatives, their structure, regulation of secretion, biological effects, catabolism. Diseases associated with changes in mineralocorticoid concentration: aldosteronism (Conn's syndrome), adrenogenital syndrome.
18. Male sex hormones: their structure and biological effects and disorders of endocrine function.
19. Female sex hormones: their structure, biological role, dysfunction. Endocrine function of the placenta (chorio-gonadotropin, chorionmammotropin).
20. Hormones of the digestive system; their chemical nature. Eicosanoids, their chemical nature and biological effects. Cytokines. Blood kinin system.

QUESTIONS FOR PREPARING FOR LABORATORY CLASSES

LESSON II

Physico-chemical properties of amino acids. Peptide bond

1. General concept about the organism chemical composition.
2. Overview of proteins.
3. Classification and structure of amino acids.
4. Proteinogenic and non-proteinogenic amino acids.

5. Peptide bond. Write pentapeptide.
6. Biuret and ninhydrin reactions (lab. works).
7. Mulder, Millon reactions on aromatic amino acids, Adamkevich and Schultz-Raspayle reactions
8. Fol reaction on sulfur-containing amino acids (lab. work). Sakaguti reaction on arginine.

LESSON III

Structure, physico-chemical properties of proteins

1. Functions of proteins. Hydrolysis of proteins, its types.
2. Bonds involved in the formation of proteins primary structure.
3. Spatial configuration of proteins: proteins secondary, tertiary and quaternary structures.
4. Folding of proteins, "chaperone" and the concept of domain.
5. Molecular weight of proteins, proteins solubility. Salting out of proteins (lab work).
6. Sedimentation reactions of proteins (lab. work).
7. Optic activity and amphotericity of proteins. Isoelectric point of proteins and its determination (lab. work).
8. Denaturation and renaturation of proteins.

LESSON IV

Simple proteins. Biologically active substances: natural peptides

1. Simple proteins, their classification. Characteristics of albumins and globulins. Determination of total protein in blood serum by biuret method. Determination of serum albumin levels. (lab. work).
2. Protein blood fractions in norm and its changes in pathology (proteinogram).
3. Protamines and histones.
4. Prolamins and glutelins.
5. Structural features of some fibrillar proteins.
6. Natural peptides, their classification, main representatives.

LESSON V

Complex proteins: metal-, phospho-, glyco-, lipoproteins

1. Classification of complex proteins.
2. Metallo- and phosphoproteins. Extraction of caseinogen from milk (lab. work).
3. Types of glycoproteins.
4. The biological role of glycoproteins. Extraction of mucin from saliva, Podopedov-Molish reaction (lab. work).
5. Structural features and biological role of lipoproteins.

LESSON VI

Chromoproteins. Hemoglobin, structural features

1. Chromoproteins, their types, role in organism (hemoproteins, flavor-proteins).
2. Heme structure. Test on hemin crystals (lab. work).
3. Structural features of hemoglobin, its heterogeneity and cooperation effect. Influence of various chemical factors on the function of hemoglobin: Bohr effect.
4. Physiological and pathological types of hemoglobin. Reactions on hemoglobin: (lab. work).
5. Myoglobin, structural features. Determination of iron in heme molecule (lab work).

LESSON VII

Nucleoproteins. Structural properties of nucleic acids. Matrix biosynthesis

1. Nucleoproteins: their types, composition and functions.
2. Extraction and hydrolysis of nucleoproteins from yeast cells. Determination of their constituents: protein, carbohydrate and phosphoric acid by specific reactions (lab. work).
3. Chemical composition of nucleic acids: the main types of purine and pyrimidine bases.
4. Primary, secondary and tertiary structures of DNA. Chargaff rules.
5. RNA – types, structural features.
6. Transcription as the stage of protein biosynthesis.
7. Translation, posttranslation processing.

8. Regulation of protein biosynthesis, the effect of activators and inhibitors on biosynthesis.

LESSON IX

The structure and properties of enzymes. Coenzymes

1. The concept of enzymes.
2. Properties of enzymes: thermolability. Determination of the optimum temperature for salivary amylase (lab. work).
3. Dependence of enzyme activity on the environment pH. Determination of the optimal pH for salivary amylase (lab. work).
4. Specificity of enzymes and its types.
5. Determination of the specificity of salivary amylase and saccharase (lab. work).
6. Coenzymes and prosthetic groups.
7. Non-vitamin coenzymes: heme, glutathione, nucleotide coenzymes, phosphoesters of monosaccharides.

X LESSON

Mechanism of enzymatic action. Determination of enzyme activity. Classification of enzymes

1. The mechanism of enzymatic action. Active center. Activation energy.
2. "Orientation", "deformation" effects. Acid-base and covalent catalysis.
3. Activity units of enzymes.
4. Classification of enzymes.
5. Metalloenzymes.
6. Polyenzymesystems.

LESSON XI

Activators and inhibitors of enzymes. Regulation of enzymatic activity

1. Activators of enzymes. Effect of activators and inhibitors on amylase activity (lab. work).

2. Inhibitors of enzymes, their types. Inactivation of the enzyme cholinesterase with proserin (lab. work).
3. Regulation of intracellular action of enzymes: feed-back principle, activation of proenzymes.
4. Regulation of enzyme activity. Induction and repression.
5. Clinical enzymology. Enzymopathology.
6. Enzymodiagnosics. Enzymotherapy.

LESSON XII

Vitamins: classification, vitamin balance disorders. Antivitamins. Fat-soluble vitamins

1. General information about vitamins. Provitamins, antivitamin.
2. Disorders of vitamin balance.
3. Vitamin A, its structural and biochemical properties, its functions, hypo- and hypervitaminosis.
4. Vitamin D, its structural and biochemical properties, its functions, hypo- and hypervitaminosis.
5. Vitamin E, its structural and biochemical properties, its functions, hypo- and hypervitaminosis.
6. Vitamin K, its structural and biochemical properties, its functions, hypo- and hypervitaminosis.

LESSON XIII

Water-soluble vitamins. Vitamin therapy

1. Vitamins B₁ and B₂, their structural and biochemical properties along with functions.
2. Vitamins PP and B₆, their structural and biochemical properties along with functions.
3. Vitamins B₁₂ and B₉, their structural and biochemical properties along with functions.
4. Vitamin C, its structural and biochemical properties, functions.
5. Quantitative determination of vitamin C in dog-rose (hip) extract, qualitative reactions on vitamin C (lab. work).

6. Qualitative reactions to B group vitamins (B₁, B₂, PP, B₆) (lab. work).
7. Application of vitamins in medicine.

LESSON XV

Structural and biochemical properties of hormones, their classification, regulation of hormones synthesis and secretion

1. General information about the endocrine system. Specific features of hormones.
2. Classification of hormones based on different principles.
3. Mechanisms of regulation hormone synthesis and secretion.
4. The relationship between the functions of the endocrine glands and interaction between hormones.
5. Receptors of hormones.

LESSON XVI

Mechanism of hormonal action. Intracellular receptors for hormones

1. Mechanism of hormonal action.
2. Adenylate cyclase system.
3. Guanylate cyclase system.
4. Calcium-polyphosphoinositol.
5. Mechanism of hormonal action with intracellular receptors.
6. Mineralocorticoids and glucocorticoids.

LESSON XVII

Biochemical properties of some hormones; their structure, secretion, biological effects. Hypo- and hypersecretion of hormones.

1. Hypothalamic-pituitary hormones, their chemical nature, biological effects, disorders.
2. Hormones of neurohypophysis.
3. Thyroid gland hormones, their structure and biological effect.

4. Hypo- and hypersecretion of thyroid hormones. Detection of iodine in thyroïdin (tireoidin) (lab. work.).
5. Endocrine function of the pancreas. Insulin structure and secretion, qualitative reactions on insulin (lab. work).
6. Mechanism of insulin action. Biological role of insulin. Diabetes mellitus.
7. Hormones of the adrenal medulla: adrenaline, noradrenaline, their structure, synthesis, biological effects. Qualitative reactions on adrenaline (lab work).
8. Catecholamines catabolism pathways.

LESSON XVIII ***Chemistry of carbohydrates***

1. The concept of carbohydrates. Biological significance and classification of carbohydrates.
2. Monosaccharides, their classification and structure.
3. Properties of monosaccharides: reducing epimerization. Sugar acids, their types. Reduction products of monosaccharides, their importance. Reactions to monosaccharides (lab. work).
4. Representatives of polysaccharides, their importance and reducing properties. Reactions to disaccharides (lab work).
5. Representatives of polysaccharides, their chemical nature and importance. Hydrolysis of starch (lab work).
6. Representatives of heteropolysaccharides, their importance.

LESSON XXI ***Chemistry of lipids***

1. The concept of lipids. Biological significance, and classification of lipids according to various principles.
2. Simple lipids, their properties. Biochemical properties of fatty acids. Vitamin F. Emulsification of fats (lab. work).
3. Complex lipids, their classification. Structure and importance of glycerophospholipids.

4. Types of sphingolipids: sphingo-phospholipids and sphingo-glycolipids, their structures, importance.
5. Sterols and steroids, their structure and importance. Reactions on cholesterol (lab. work).
6. Determination of unsaturated fatty acids (lab. work).

COLLOQUIUM PROCEDURES

The purpose of the lesson: to determine the degree of mastery of the subject among students via an individual survey.

The teacher calls 4 students to answer. The date of the month, the student's last name, and the ticket number are indicated on the sheet.

The ticket contains 4 questions with 2.5 points each: 3 colloquium questions, and one situational task. If the structure or scheme is required in the question, but the student can not write them, giving only an oral answer, the answer is evaluated with a maximum of 1 point. It is not necessary to write the full text of the answer.

When students answer questions, it is important to pay attention to the extent to which they have mastered the subject.

Finally, the teacher explains the next lesson subject according to the calendar-theme plan.

PRESENTATION TOPICS FOR INDEPENDENT STUDY ON STATIC BIOCHEMISTRY

The teacher distributes the presentation topics individually for each group.

REFERENCES

1. Azizova G.I., Dadashova A.R., Amirova M.F., Vahabova G. R. Biochemistry laboratory manual theory and methods, Baku, 2019.
2. Harvey R.A., Ferrier D.R. Lippincott's illustrated reviews. Biochemistry. 6th edition.
3. Nelson D.L., Cox M.M., Lehninger. Principles of biochemistry. 5th edition.

4. Islamzade F.I., Efendiyev AM, Islamzade F.Q. Fundamentals of human biochemistry (textbook, volume I). Baku, 2015.
5. Islamzade F.I., Islamzade F.Q., Efendiyev AM. Fundamentals of human biochemistry (textbook, volume II). Baku, 2015.
6. Efendiyev A.M., Islamzade F.G., Garayev A.N., Eyyubova A.A. "Laboratory exercises in 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 (to prepare for master's degree). 2018.
9. Lecture material.