Approved
at the Chair of Biochemistry and Clinical Biochemistry
meeting of 22/01/2024, minute no. 9
Head of the Chair, MD, dr., prof.
_____ Olga Tagadiuc

SYLLABUS
in Biochemistry for 1st year students of Faculty of Dentistry,
spring semester (1st), academic year 2023-2024

N	Date	Theoretical classes	Practical classes
1	05-09.02	Biochemistry in the medical education system. Amino acids: structure, role. The role and classification of proteins. Levels of organization of protein structures. Collagen. General notions about calcium-binding proteins.	The importance of biochemistry for medical disciplines. Functional groups. Types of functional groups specific for biomolecules. Their general properties. Types of chemical bonds specific for biomolecules. Their general properties. Amino acids – role in the living organisms. Proteinogenic and non-proteinogenic amino acids. Classification of amino acids according to their chemical structure, physico-chemical properties and biological principle. Acid-base properties of amino acids. Polypeptide theory of the protein structure. Peptide bond properties. Name and reading the amino acids in peptides and proteins. N- and C- terminal amino acids.
2	12-16.02		Role, structure and clasification of proteins. Protein levels of structural-functional organization: primary, secondary, tertiary and quaternary structures, general description. Chemical bonds that stabilize each structural level. Basic notions about protein structural domains. Proteins classification. Simple proteins: albumins and histones – general characteristic, structural peculiarities. Biologic role. Conjugated (complex) proteins: nucleo-, phospho-, lipo-, glyco-, metallo- and chromoproteins (hemo- and flavoproteins), their general characteristic. Fibrillar proteins: collagen – peculiarities of amino acids composition and structure. Biologic role. Ca^{2+}-binding proteins (Ca^{2+}-ATPase, calmodulin and collagen) – peculiarities of the amino acid composition that ensure calcium binding. Biomedical role.

			Chromatographycal identification of the amino acids
3	19-23.02	Physico-chemical properties of proteins. Methods of protein separation and purification. Nucleoproteins. Their biological role. Classification. The chemical structure of nucleic acids. Nitrogen bases, nucleosides and nucleotides - structure, nomenclature and properties.	Physico-chemical properties of proteins. Amphoteric properties of the protein. The electric charge of the protein. Factors that determine the electric charge of the protein. Isoelectric point and state. The solubility of the proteins. Hydrophilic properties of the proteins according to their amino acidic composition, structural peculiarities, solution pH and temperature. Colloidal solutions of proteins. States of the colloidal solutions: sol, gel and xerogel. Denaturation of proteins, agents causing denaturation. Structural changes in denaturated proteins. Biomedical role. Methods of protein separation, purification and analysis: a) salting, b) dialysis; c) electrophoresis; d) chromatography. Method's principle and biomedical importance. *Dialysis*
4	26.02-01.03		Types of nucleic acids, functions and cell location. Chemical composition of nucleic acids: nitrogenous bases, pentoses and phosphate. Nucleosides and nucleotides – role, structure. Primary structure of DNA. Polynucleotide chain. Phosphodiester bonds. Secondary structure of DNA. Watson-Crick model. DNA double helix and its conformations (types B, A and Z). Levels of compaction of DNA molecule in prokaryotes and eukaryotes (nucleosomes, solenoid, chromatin, chromosomes). RNA secondary and tertiary structures. *Molisch's reaction. Molybdenum reaction.*
5	04-07.03	Chemical nature and structure of the enzyme. Vitamins as coenzymes. Mechanism of action of the enzymes. Nomenclature and classification of enzymes. Specificity of enzymes. Regulation of the enzyme activity. Activation and inhibition of enzymes.	**Concluding test on chapter „Structure of proteines and nucleic acids”.**
6	11-15.03		Enzymes – definition and biological role. Properties that enzymes share with and are different from non-organic catalysts. Chemical nature of enzymes. Evidence of the proteic nature of enzymes. Structure of the enzyme. Active and allosteric sites. Simple and conjugated enzymes. Notions of holoenzyme, apoenzyme, cofactor, coenzyme, co-substrate and prosthetic group. Coenzyme

			function of vitamins and microelements. Structure of the coenzymes derivatives of the vitamins B_1, B_2, B_6, PP and ascorbic acid. Their metabolic role. Mechanism of enzyme catalysis. The active center of the enzyme and its role in catalysis. The role of mutual conformational changes of the enzyme and substrate molecules in catalysis. Enzyme classification and nomenclature. Overview of enzyme classes. The specificity of the enzyme – types, examples. *Identification of vitamins B1, B2, B6, PP (B5).*
7	18-22.03	Bioenergetics. Metabolism: role, phases, stages. Energetic regulation of metabolism. Oxidative decarboxylation of pyruvic acid. Krebs cycle.	Enzyme kinetics. Influence of enzyme and substrate concentration, pH and temperature on enzyme activity. Units of enzyme activity (international unit, katal, specific activity). Activation of enzymes by partial proteolysis. Proenzymes. Inhibition of enzyme activity (specific and non-specific, reversible and irreversible, competitive and non-competitive). Regulation of enzyme activity (allosteric and covalent regulation). Importance of the *feed-back* inhibition principle. Isoenzymes – structural and functional peculiarities, biomedical importance. Enzyme usage in medicine: enzyme diagnostics; enzyme therapy. Methods of obtaining and purifying the enzyme. *Alfa-amylase activity assay.*
8	25-29.03		Introduction to metabolism. Catabolism and anabolism. Metabolic pathways. Amphibolic stage of the metabolism, its role. Thermodynamic laws. Notions regarding enthalpy, entropy and free energy. Standard free energy, its significance. Endergonic and exergonic reactions. High-energy compounds: role, classification, main representatives, structural peculiarities. Chemical structure and function of ATP. ATP cycle. ATP hydrolysis pathways. Mechanisms of ATP biosynthesis. Energetic regulation of cellular metabolism. Indices of the energetic state of the cell. Oxidative decarboxylation of pyruvate – enzyme complex, coenzymes, overall reaction, stages, regulation, connection with Krebs cycle and electron transporting chain. Biological role. The tricarboxylic acid cycle (Krebs cycle): functions, reactions, enzymes, overall reaction, connection with the electron transporting chain, energy output,

			regulation. Anaplerotic reactions. Importance. The role of citrate in homeostasis of mineralized tissue. *Determination of pyruvate in the urine*.
9	01-05.04	Biological oxidation. Respiratory chain and oxidative phosphorylation.	Biological oxidation. Dehydrogenation – energy source for ATP biosynthesis. Reactions, enzymes and coenzymes of dehydrogenation. Electron transport chain (ETC) – location, the biological significance. Structure and oxido-reduction properties of the main acceptor of protons and electrons (NAD^+, FAD, FMN, CoQ). General descriptions of the cytochromes and Fe-S proteins structure. Redox-potential of ETC components. Connection between the redox potential of the components of the respiratory chain, the generated free energy and ATP synthesis. Enzyme complexes of ETC. Inhibitors of the ETC. Oxidative phosphorylation. Phosphorylation points. Regulation of the ETC function. The ratio P/O. The mechanism of phosphorylation and oxidation coupling (Mitchell hypothesis). ATP synthase. Notions regarding ATP synthase inhibitors. Notions regarding uncoupling of oxidation and phosphorylation processes and uncoupling agents. Examples of physiological and pathological uncoupling. *Qualitative and quantitative determination of catalase*.
10	08-12.04		**Concluding test on chapters "Enzymes" and "Bioenergetics"**
11	15-19.04	Carbohydrates: biological role and classification. Digestion and absorption of carbohydrates. Glycogen metabolism.	The biological role of carbohydrates. Classification and structure of the carbohydrates. Biochemical mechanisms of digestion and absorption of carbohydrates. Disaccharide intolerance and its impact on phospho-calcium homeostasis and mineralized tissues. The impact of dietary carbohydrates on the structural-functional state of the stomatognathic system dental tissues. Glucose transport from blood into tissues – glucose transporters (GLUT). Carbohydrates usage in the tissues. Glycogen metabolism: glycogenogenesis and glycogenolysis. Reactions, enzymes, reciprocal regulation of the processes. General notions about glycogenoses. *Fehling reaction. Seliwanoff reaction.*
12	22-26.04		Glycolysis reactions, enzymes. The overall reaction and energy output of anaerobic glycolysis. The scheme and energy output of aerobic oxidation of glucose. Shuttle systems (malate-aspartate and glycerol phosphate) for the reducing equivalents transportation from cytosol into mitochondria. Their

			importance. Gluconeogenesis – substrates, reactions, enzymes, overall reaction. General notions about Cori cycle. Reciprocal regulation of glycolysis and gluconeogenesis. Influence of insulin, glucagon, catecholamines and glucocorticoids. *Determination of glucose in blood serum - enzymatic method (with glucose oxidase)*
13	29.04-03.05	Metabolism of glucose. Aerobic and anaerobic glycolysis. Gluconeogenesis. Pentose phosphate pathway. Fructose and galactose metabolism	Pentose-phosphate pathway of glucose oxidation. Biological role of this process, reactions of the oxidative phase, enzymes, coenzymes. Overall equation of I stage and of the entire process. Fructose metabolism – liver and muscle pathways: partial reactions, enzymes, biological role. Hereditary disorders of fructose metabolism. Galactose metabolism: partial reactions, enzymes, biological role. Hereditary pathologies of galactose metabolism. Laboratory markers of carbohydrate homeostasis (basal glycaemia, glycated hemoglobin). *Reaction of fructose identification in urine*
14	14-17.05		**Concluding test on chapter "Carbohydrate metabolism".**
15	20-24.05	Regulation of carbohydrate metabolism. Disorders in carbohydrate metabolism. The influence of carbohydrates on dental pathology.	**Individual work presentation.**

NOTE:
Responsible for the theoretical classes– PhD, dr., associated professor, Tatiana Timercan;
Duration of theoretical class - 2 hours/ in 2 weeks, practical class - 2 hours.