DESCRIPTION OF COURSE UNIT FOR DOCTORAL STUDIES AT VILNIUS UNIVERSITY

Scientific Area/eas, Field/ds of Science	Medical and health sciences (M 000): Medicine (M 001) Natural sciences (N 000): Biochemistry (N 004); Biology (N 010)			
Faculty, Institute, Department/Clinic	Faculty of Medicine Institute of Biomedical Sciences Department of Physiology, Biochemistry, Microbiology and Laboratory Medicine			
Course unit title (ECTS credits, hours)	**Clinical Biochemistry** 8 credits (212 hours)			
Study method	**Lectures**	**Seminars**	**Consultations**	**Self-study**
Number of ECTS credits	-	-	1	7
Method of the assessment (in 10 point system)	Report presentation and evaluation: the report is presented on a focused topic, which is approved by the coordinating lecturers (the PhD student has to analyse, review and present the most recent scientific publications related to the relevant topic). Criteria for the evaluation of the report: (a) relevance, novelty and adequacy of the material provided to the chosen topic (3 points); b) general structure of the report, presentation of knowledge, argumentation, conclusions (4 points); c) answering questions, ability to participate in a discussion (3 points).			

PURPOSE OF THE COURSE UNIT

To provide knowledge about modern technologies, methodologies and research in laboratory medicine, their practical application in scientific and clinical work. To be able to evaluate laboratory tests and the influence of environmental factors on the results of laboratory tests. To deepen the knowledge about the biochemical processes in the human body and to help better understand and analyse the results of laboratory research in clinical biochemistry.

THE MAIN TOPICS OF COURSE UNIT

Methods of analysis in the clinical chemistry laboratory. Optical methods: photometry, spectrophotometry, fluorometry, luminometry, turbidimetry and nephelometry. Electrochemical methods: potentiometry, amperometry, biosensors. Electrophoresis. Chromatography. Mass spectrometry. Methods for the analysis of enzyme activity and substrates. Immunochemical test methods. *In vitro* diagnostic medical devices, laboratory automation. Selection and evaluation of research methods. Basics of electronic laboratory data processing. Quality management and optimization of laboratory activities.

Cell membrane. Structure and biological role. Migration of materials across the membrane. Membrane diseases.

Carbohydrates. Classification. Relationship between carbohydrate, fat and protein metabolism. Glucose metabolism, its regulation. Metabolism and regulation of other carbohydrates (i.e. galactose, lactose, glycogen). Diabetes. Glycosylated hemoglobin. Other congenital and acquired metabolic disorders (i.e. lactose intolerance, galactosemia, accumulation disorders). Laboratory diagnosis of carbohydrate metabolism disorders.

Lipids and lipoproteins. Edible fats, their digestion and resorption, disorders of this process. Classification of lipids and their general characteristics. Fatty acids of human body, products of their metabolism. Peroxide oxidation of lipids. Lipolysis. Tissue lipases, hormonal regulation of their activity. The role of the liver in lipid metabolism. Ketones, ketogenesis. Plasma lipoproteins, their metabolism. Lipoprotein lipase. Apolipoproteins. Cholesterol synthesis and its regulation. Dyslipoproteinemia. Pathogenesis of atherosclerosis in terms of lipoprotein metabolism disorders.

Proteins, amino acids. Protein biological functions, chemical composition, structures, metabolism. The most important proteins in blood plasma and urine. Inflammation and acute phase proteins. Dysproteinemia, paraproteinemia. Proteinuria. Amino acid metabolism, congenital and acquired disorders of their metabolism.

Enzymes. Classification and nomenclature. Enzyme specificity, mechanisms of action, activation and inhibition, influence of environmental conditions on enzyme activity. Isoenzymes. Importance of enzymes in diagnosis and treatment. Enzymatic pathologies.

Nucleic acids. Structure and functions. Nucleic acid and purine metabolism. Gout. Other congenital and acquired disorders of purine metabolism.

Porphyrins and pigments. Metabolism. Bilirubin metabolism. Laboratory differential diagnosis of jaundice. Hemoglobin variants and structures. Hemoglobinopathies. Thalassemia. Iron metabolism. Biochemical markers of anemia.

Electrolytes. Sodium, potassium, chloride, calcium, phosphorus metabolism, disorders. Blood gas. Acid-base balance and its disorders. Key indicators, clinical significance. Buffer systems (acid carbonates, phosphates, proteins). Acidoses and alkaloses. Renal regulatory systems. Gas exchange in the lungs, oxygen metabolism.

Vitamins and trace elements. Classification. Hypo- and hypervitaminosis. Free radical oxidation. Antioxidant systems. Importance of trace elements and research methods.

Hemostasiology. Primary and secondary haemostasis, laboratory tests. Coagulation factors, their determination, clinical significance. Laboratory evaluation of the fibrinolytic system. Thrombophilia. Action of anticoagulants. Anticoagulation control.

Endocrine system. Chemical nature of hormones, classification, transport, mechanisms of action. Regulation of hormone synthesis and secretion. Laboratory diagnosis of functional thyroid, parathyroid, adrenal, pancreatic, pituitary, hypothalamic disorders. Catecholamines.

Gastrointestinal tract and its laboratory diagnosis. Pancreatitis. Liver structure, functions. Enterohepatic circulation. Composition and production of bile. Laboratory differential diagnosis of liver diseases.

Kidneys and urinary tract. Renal structure, functions. Glomerular filtration. Urine composition, properties. Non - protein nitrogenous substances. Laboratory differential diagnosis of kidney diseases.

Cardiovascular system. Universal definition of myocardial infarction. Laboratory markers of heart damage and failure.

Bone structure, functions, metabolism. Signs of bone damage.

Formation and composition of **cerebrospinal fluid**, its tests and differences from blood serum.

Pregnancy. Biochemical changes in body fluids during pregnancy. Maternal blood serum tests in prenatal diagnosis.

Therapeutic drug monitoring. Pharmacokinetics, pharmacodynamics and drug bioavailability. Drug concentration testing.

Cancer markers. Classification, clinical interpretation. Oncogenes.

RECOMMENDED LITERATURE SOURCES

1. Burtis CA, Ashwood ER, Bruns DE. Tietz Textbook of Clinical Chemistry and Molecular Diagnostics. Saunders-Elsevier, 6th Edition, 2017
2. McPherson RA, Pincus MR. Henry's Clinical Diagnosis and Management by Laboratory Methods. Saunders-Elsevier, 24th Edition, 2021
3. Bishop ML, Fody EP, Schoeff LE. Clinical chemistry: Techniques, Principles, Correlations. 8th Edition. Jones & Bartlett Learning, 2017.
4. Baynes J.F., Dominiczak N.H. Medical Biochemistry. Elsevier, 5th Edition, 2018
5. Stryer L., Berg J., Tymoczko J., Gatto G. Biochemistry. W.H. Freeman; 9th edition, 2019.
6. Kučinskienė ZA. Klinikinės biochemijos ir laboratorinės diagnostikos pagrindai. Vilniaus universiteto leidykla, 2008.
7. Sunheimer R., Graves L. Clinical Laboratory Chemistry. Pearson, 2nd Edition, 2018.
8. Kumar V., Gill K.D. Basic Concepts in Clinical Biochemistry: A Practical Guide. Springer, 2018.
9. Rae P., Crane M., Pattenden R. Clinical Biochemistry (Lecture Notes). Wiley, 10th Edition, 2017.
10. Clarke W., Marzinke M. Contemporary Practice in Clinical Chemistry. AACC Press, 4th Edition, 2020.

CONSULTING LECTURERS

1. Coordinating lecturer: Dovilė Karčiauskaitė (Assoc. Prof. Dr.).

2. Dalius Vitkus (Assoc. Prof. Dr.).

APPROVED:

By Council of Doctoral School of Medicine and Health Sciences at Vilnius University: 29th of September 2022

Chairperson of the Board: Prof. Janina Tutkuvienė