Subject: **MEDICAL BIOCHEMISTRY 2**	Subject type:	**compulsory**
Study year: **2**	Content:	**3/3 summer term**
Study program: **General Medicine**		

Learning outcomes *(Aim of the course)*

The graduate will understand the course of biochemical processes of physiological life processes as events taking place in individual organs and tissues of man. He can distinguish basic pathological processes from physiological processes, while he perceives biochemical processes in individual organs and tissues as a part of cellular metabolism. The graduate masters the laws of biochemical regulation of metabolism and learns the basics of clinical-biochemical diagnostics.

Education: lectures, seminars, practical exercises
Assessment: written tests and oral exam

Syllabus

Metabolism of nitrogen containing compounds
Amino acid metabolism: general reactions of amino acid degradation, carbon skeleton degradation. Conversion of amino acids into physiologically active substances: biosynthesis and degradation of biogenic amines and polyamines. Formation of ammonia in the body, synthesis of urea. Glucose-alanine cycle. The importance of amino acids in the formation of other substances (e.g. synthesis of creatine, glutathione, taurine, carnosine, ethanolamine, serotonin). Biosynthesis of non-essential amino acids - reactions, significance. Disorders of amino acid metabolism.

Nucleotide metabolism: biosynthesis and degradation of purine and pyrimidine nucleotides. Biosynthesis of deoxyribonucleotides. Regulation of nucleotide metabolism. Inhibitors of purine and pyrimidine nucleotide biosynthesis and their relation to cancer chemotherapy. Biosynthesis of nucleotide coenzymes – FAD, NAD^+, CoA. Salvage (recycling) reactions. Disorders of nucleotide metabolism.

Biochemistry of nucleic acids
Arrangement of genetic material, structure of genes. Genetic code and its properties. Non-nuclear forms of nucleic acids (NA). DNA replication in prokaryotic and eukaryotic organisms. DNA mutations and repairs. DNA transcription. Biosynthesis of tRNA, mRNA and rRNA. NA biosynthesis inhibitors. Non-coding RNA. Gene manipulations and gene therapy. Diagnostic use of NA analysis (e.g. PCR method). Reverse transcription and viruses (e.g. HIV, SARS-CoV-2).

Proteosynthesis
Proteosynthesis in prokaryotic and eukaryotic cells: amino acid activation, initiation, elongation and termination of proteosynthesis. Inhibition of proteosynthesis. Cotranslational and posttranslational modification of proteins and peptides. Protein folding. Secretory and membrane proteins - synthesis and distribution of synthesized proteins. Operon theory. Induction and repression of transcription. Regulation of gene expression.

Biochemistry of organs and tissues

Biochemical function of blood – peculiarities of metabolism in erythrocytes. Plasma proteins - methods of determination, significance. Tetrapyrrole metabolism - heme biosynthesis and its regulation. Structure and function of hemoglobin. Hemoglobin derivatives. Degradation of hemoglobin and the formation of bile pigments. Blood clotting. Acid-base balance (ABB) and its maintenance. Buffer systems. ABB disorders. Metabolism and function of water in living systems. Minerals in the body – their role in metabolism, diagnostic importance and diseases associated with them.

Biochemistry and liver function. Metabolism and markers of liver damage. Foreign substances (xenobiotics) in the environment and in the organism. Biotransformation of xenobiotics - reactions, enzymes, significance.

The role of the kidneys in metabolism. Biochemical processes taking place in the kidneys. Renal regulation of ion and water exchange. The role of the kidneys in maintaining ABB. The importance of the liver and kidneys in the detoxification of substances.

Biochemistry of connective and supporting tissue. Biochemistry of skeletal, cardiac and smooth muscle – contraction, relaxation. Composition and metabolism of hard tissue. Biochemistry of calcification, process of mineralization and demineralization, regulation of hard tissue metabolism. Biochemical nature of nerve excitation transduction. Mediators (neurotransmitters). Biochemistry of membrane receptors. Skin biochemistry. Chemical processes of vision.

Biochemical nature of selected pathological processes e.g. viral infection, prion diseases, neoplastic process. Biochemical nature of apoptosis.

Biochemical bases of nutrition. The role of saccharides, lipids and proteins in nutrition. Basic components of food, energy content of nutrients. Basic requirements for proper nutrition. Special nutritional problems (e.g. malnutrition, starvation, obesity, vegetarianism). Digestion and absorption of substances in the mouth, stomach and small intestine. Biochemical processes in the large intestine.

Regulation of metabolic processes

Basic regulatory mechanisms of intermediary metabolism at the cellular level (e.g. cell compartmentation, limiting metabolites, allosteric control of key enzymes, change in enzyme concentration, induction and repression). Relationships between carbohydrate, lipid, protein and nucleic acid metabolism – key metabolites and enzymes of intermediary metabolism. Principles of hormonal regulation. Chemical structure of hormones and distribution. Mechanisms of action of hormones. The importance of NO in regulation. The role of the CNS in the regulation of metabolism.

Fundamentals of clinical biochemistry

Biological material. Basic analytical reactions and methods for determination of biologically active substances (e.g. use of enzymes in diagnostics, inflammatory markers).