Subject: **MEDICAL CHEMISTRY**	Subject type:	**compulsory**
Study year: **1**	Content:	**2/2 winter term**
Study program: **General Medicine**		

Learning outcomes *(Aim of course)*

The graduate will acquire knowledge of general, bioinorganic chemistry, analytical and bioorganic chemistry. He knows the structures and functions of medically important substances, knows the importance of acid-base properties of substances, as well as energy processes and understands the essence of chemical processes taking place in living systems. The acquired knowledge will contribute to a better understanding of the functions of the whole organism and is the basis for successful mastery and correct understanding of biochemistry, which is a necessary theoretical basis of several medical disciplines.

Education: lectures, seminars and practical excercises

Assesment: written tests and written exam

Syllabus

Latin and international nomenclature of inorganic compounds. Selected chemical elements – biological and toxicological properties, importance in medicine. The formation of chemical bonds and their properties.

Dispersive systems: characteristic, types and properties of dispersive systems (diffusion and osmosis). Biological importance of water. The expression of the composition of the solutions. Electrolytes – characteristic, electrolytic dissociation, ionic strength, solubility product. Acid-base theory. Autoprotolysis of water, pH – weak acids and bases, salts hydrolysis. Buffer solutions – Henderson-Hasselbalch equation. Colloid solutions – properties.

Chemical reactions: classification, energetics, catalysis. Chemical thermodynamics – basic laws and their application to a living organism. Reaction kinetics and its importance for the regulation of biochemical processes. Oxidation-reduction processes – redox potential, basic types of oxidation-reduction reactions in living systems.

Biologically and medically important **organic compounds and their derivatives**: structure, nomenclacture, reactions. Carboxylic acids and derivatives of carboxylic acids (substitutional and functional). Derivatives of carbonic acid (e.g. urea, guanidine, creatine). The important reactions of organic compounds in biochemistry. Nitrogen, phosphorus and sulphur containing organic compounds – structure, medical and toxicological importance. Biochemically and medically important derivatives of heterocyclic compounds.

Saccharides: structure, chemical properties (e.g. optical isomerism, mutarotation). Reactions of saccharides: oxidation, reduction, dehydration, esterification and glycosides formation. Oligosaccharides: important saccharides. Polysaccharides: homopolysaccharides (e.g. starch, glycogen, cellulose, dextran, inulin), heteropolysaccharides (e.g. proteoglycans, glycoproteins, GAG) – structure and biomedical importance.

Lipids: structure, chemical properties, classification and biological function. Fatty acids (saturated, unsaturated, essential): structure, reactions, importance. Eicosanoids: structure, reactions, importance. Sphingolipids: structure, reactions, importance. Complex lipids: acylglycerols, phospholipids, glycolipids and lipoproteins. Derived lipids: isoprenoids, terpenes, steroids – structure, classification, importance. Eicosanoids – structure, classification and importance. Lipids as a part of biological membranes, participation in signal transduction.

Amino acids and peptides: properties, structure and classification. Properties of amino acids in a solution and in the electric field: titration curve, isoelectric point. Essential amino acids. Reactions of amino acids. Formation and properties of peptide bond. Characteristics of peptides: biologically important peptides and polypeptides.

Proteins: chemical properties, structure, classification, importance. Properties of proteins in a solution: solubility, isolation methods, fractionation of proteins. Covalent and non-covalent interactions. Reversible and irreversible denaturation. Simple and complex proteins. The relationship between the structure and biological importance of proteins (myoglobin, hemoglobin, collagen, elastin). Blood plasma proteins and thier diagnostic application.

Nucleic acids: structure of purine and pyrimidine bases, formation and structure of nucleosides and nucleotides. Biochemically and biologically important nucleotides and their derivatives. Nucleic acids (NA): composition, structure, classification, importance. Complementarity of bases and its importance, Chargaff rule. The use of NA for therapeutic and diagnostic purpose.

Natural compounds: structure, chemical properties and biological importance. Vitamins: classification, structure, chemical properties and biological importance. Terpenes, alkaloids and flavonoids: structure, properties, biological importance and medical application.

Biological membranes: structure, membrane proteins, fluidity of membranes. Types of membrane transport (e.g. passive and facilitated diffusion, active transport, endocytosis, exocytosis).

Calculation in Medical Chemistry: stoichiometry, preparation of solution (e.g concentration, dilution), pH, spectrophotometry.

Basic methods and techniques in analytical chemistry: volumetric analytical methods (e.g. types of titrations and indicators). Precipitation reactions and solubility product. Principles and practical application of spectrophotometry. Methods and application of chromatography. The principles of proof and determination of selected compounds (e.g. glucose, fatty acids, amino acids, proteins, NA).