Subject: **MEDICAL CHEMISTRY**	Subject type:	**compulsory**
Study year: **1**	Content:	**2/3 winter term**
Study program: **Dental 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, including substances used in dentistry. They will understand the importance of acid-base properties of substances and the nature of chemical processes taking place in living systems. The acquired knowledge will contribute to a better understanding of the events taking place in the oral cavity and the body and is the basis for successful mastery and correct understanding of biochemistry, which is a good theoretical basis for several medical disciplines.

Education: lectures, seminars and practical exercises
Assessment: 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.

Dispersion systems: characteristics, types and properties (e.g. diffusion, osmosis). Water – biological significance, solutions. Electrolytes - characteristics, electrolytic dissociation, ionic strength. Theory of acids and bases: pH, hydrolysis of salts. Buffers – weak acids and bases, Henderson-Haselbalch equation. Formation of insoluble compounds – solid phase.

Chemical reactions: classification, energetics, catalysis. Equilibrium at the phase interface, adsorption, adsorption isotherms, membrane phenomena (Donnan equilibrium). Crystallographic systems. Oxidation-reduction reactions. Electrodes, galvanic cells, electrode potential. The biological aspects of oxidation-reduction reactions.

Biologically and medically important **organic compounds and their derivatives**: structure, nomenclature, reactions. Carboxylic acids and derivatives of carboxylic acids (substitutional and functional). Derivatives of carbonic acid - carbamic acid, urea, guanidine, creatine, creatinine. 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.

Metals and their alloys in dental medicine: Formation of metal crystals. Crystal lattice. Metallic bond. Process of metal preparation. Cooling curves of metals and their alloys. Phase diagrams. Eutectic point. Properties of metals. The noble metals and their alloys. General metal alloys. Titanium and its alloys. Amalgams, their composition and properties. Setting reaction of amalgams. Dental porcelain and cements. Metal-ceramic system.

Macromolecules prepared by polymerisation, polyaddition and polycondensation used in stomatology. Structure of polymers, polymerisation reactions, the degree of polymerisation. Supramolecular structure of polymers, the amorphous and crystal domains in polymers. The mechanism of polymerisation, polyaddition and polycondensation. Dental polymers. Plasticizers, composites. Crown and basal polymers. Metal and polymer bonding, Silicoater method.

Impression materials: classification, chemical composition, setting reactions and usage of impression materials. Rigid reversible and irreversible impression materials. Impression plaster: types, setting reaction, factors affecting setting. Elastic impression materials: agar and alginates, elastomers.

Saccharides: structure, properties (e.g. optical isomerism, mutarotation), classification and biological function. Reactions of saccharides: oxidation, reduction, dehydration, esterification and glycosides formation. Oligosaccharides (e.g. disaccharides) – structure and biomedical importance. 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, peptides and proteins: properties, structure and classification. Reactions of amino acids. Formation and properties of peptide bond. Characteristics of peptides: biologically important peptides and polypeptides. Properties of proteins in a solution. Covalent and non-covalent interactions. Simple and complex proteins. The relationship between the structure and biological importance of proteins (e.g. myoglobin, hemoglobin, collagen, elastin). Blood plasma proteins and their diagnostic application.

Nucleic acids: structure of purine and pyrimidine bases, formation and structure of nucleosides and nucleotides. Biochemically and biologically important nucleotides, nucleoside diphosphates, nucleoside triphosphates. 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).