## *Lectures and practical exercises*

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| **Subject:** | **Medical Chemistry** | **Code:** | *ULCHBKB/MCH-GM/22* |
| **Study Programme:** | *General Medicine* | **Study Period:** | *1. semester* |
| **Evaluation:** | *Exam* | **Subject Type:** | *compulsory* |
| **Content:** | *2 h lectures and 2 h practical exercises / week* | | *Total 56 hours* |

Workplace: **Department of Medical and Clinical Biochemistry, UPJŠ in Košice, FM**

| ***Week*** | ***Lectures***<br>https://portal.lf.upjs.sk/index-en.php | ***Practical Lessons***<br>https://portal.lf.upjs.sk/index-en.php |
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| 1. | **INTRODUCTION TO MEDICAL CHEMISTRY**<br>- Definition of terms<br>- Properties of elements, micro- and macro-elements<br>- Types of chemical bonds and interactions<br>**WATER AND SOLUTIONS**<br>- Water, properties and biological function of water<br>- Disperse systems, properties of disperse systems<br>- Solutions | **PRINCIPLES OF LABORATORY TECHNIQUE**<br>- Laboratory safety rules<br>- Equipment of laboratory bench<br>- exercise: *Volume measurement* |
| 2. | **BIOCHEMICAL REACTIONS PROCESS RULES I**<br>- Kinetics of chemical reaction<br>- Effect of reactant concentration, temperature on reaction rate, order of reaction rate<br>- Acid-base reactions – pH, hydrolysis of salts<br>- Buffer systems – Henderson-Hasselbalch reaction<br>- Equilibrium of a chemical reaction, equilibrium constant | **NOMENCLATURE OF INORGANIC COMPOUNDS (English)**<br>**CALCULATIONS**<br>- Stoichiometric calculations |
| 3. | **BIOCHEMICAL REACTIONS PROCESS RULES II**<br>- The basics of chemical thermodynamics<br>- Gibbs free energy, chemical reaction spontaneity<br>- Precipitation reactions, solubility equilibrium<br>- Complexation reactions<br>- Redox reactions – redox potential<br>- Electrode potential of metals | **CALCULATIONS**<br>- Solutions<br>**VOLUMETRIC ANALYSIS**<br>- exercise: *Standardization of NaOH solution* |
| 4. | **ORGANIC CHEMISTRY I**<br>- Hydrocarbons – structure, reactions<br>- Derivatives of hydrocarbons – alcohols and aldehydes<br>- Carboxylic acids – structure, reaction, importance<br>- Functional and substitutional derivatives of carboxylic acids | **CALCULATIONS**<br>- Calculation of pH of acid, base, and salt solutions<br>**pH MEASUREMENT**<br>- exercise: *Preparation and pH measurement of acetate buffers* |
| 5. | **ORGANIC CHEMISTRY II**<br>- Carbonic acid derivatives<br>- Organic sulphur, phosphorus, nitrogen compounds, structure, and biological significance<br>- 5-membered and 6-membered heterocycles with one or more heteroatoms | **CALCULATIONS**<br>- Calculation of buffers pH<br>**BUFFER SYSTEMS**<br>- exercise: *Effect of acids and bases on pH of buffers* |
| 6. | **1st REVISION TEST***<br>**ORGANIC CHEMISTRY III**<br>- Biochemically and medicinally important derivatives of heterocyclic compounds (e.g. purines, pyrimidines, medicinal drug, dyes) | **CALCULATIONS**<br>- Balancing redox reactions<br>**ORGANIC COMPOUNDS**<br>- exercise: *Preparation of esters of carboxylic acids* |
| 7. | **SACCHARIDES AND THEIR IMPORTANT DERIVATIVES**<br>- Saccharides – classification, structure, reactions | **CALCULATIONS**<br>- Spectrophotometric calculations |

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| | - Biologically important monosaccharides, disaccharides, and their derivatives<br>- Oligosaccharides and polysaccharides – classification, structure, importance<br>- Complex saccharides (e.g. peptidoglycans, proteoglycans, glycoproteins) and their importance | **SPECTROPHOTOMETRY**<br>- exercise: *Spectrophotometric determination of copper with ammonia* |
| 8. | **LIPIDS AND STEROIDS**<br>- Basic structure and classification of lipids<br>- Fatty acids (FA) – structure, reactions, classification<br>- Triacylglyceroles (TAG) and sphingolipids – structure, classification, properties<br>- Eicosanoids – classification, biological importance<br>- Complex lipids (e.g. phospholipids, lipoproteins)<br>- Derivated lipids (e.g. steroids) – classification, structure, biochemical importance | **SACCHARIDES**<br>- exercise: *Nitrochromium reaction*<br>- exercise: *Seliwanoff's reaction*<br>- exercise: *Tollen's reaction*<br>- exercise: *Tollen's reaction (silver mirror)*<br>- exercise: *Fehling's reaction*<br>- exercise: *Lugol test* |
| 9. | **AMINO ACIDS AND PEPTIDES**<br>- Amino acids (AA) – classification, structure, reaction, biochemical properties<br>- Important derivatives of AA – biochemical significance<br>- Peptides – peptide bond, classification, properties<br>- Biochemically important of peptides (e.g. glutathion) | **LIPIDS**<br>- exercise: *Hydrolysis of neutral lipids by lipase*<br>- exercise: *Detection of double bonds in fatty acids* |
| 10. | **PROTEINS**<br>- Proteins – structure, classification, physical-chemical properties, biochemical function<br>- Biological and biomedical importance proteins (e.g. hemoglobin, collagen, elastin)<br>- Complex proteins and their function<br>- Isolation methods and their use in medical practice | **AMINO ACIDS**<br>- exercise: *Ninhydrin reaction*<br>- exercise: *Xanthoprotein reaction*<br>- exercise: *Foli's reaction*<br>- exercise: *Determination of unknown protein* |
| 11. | **NUCLEIC ACIDS**<br>- Nucleosides and nucleotides – structure, properties<br>- DNA – structure, classification, properties, function<br>- RNA – structure, classification, properties function<br>- Nucleic acid analysis techniques, their use in medical practice (e.g. restriction enzymes, PCR) | **PROTEINS**<br>- exercise: *Reversible precipitation of proteins*<br>- exercise: *Irreversible precipitation of proteins*<br>- exercise: *Biuret reaction* |
| 12. | **2nd REVISION TEST***<br>**OTHER MEDICALLY IMPORTANT COMPOUNDS**<br>- Terpenes, alkaloids and flavonoids – structure physical-chemical properties, biological significance<br>- Vitamins – structure, classification, properties, biochemical importance (e.g. coenzymes) | **NUCLEIC ACIDS I**<br>- exercise*: Isolation of nucleoproteins from eukaryotic cells*<br>- exercise*: Hydrolysis of nucleoprotein* |
| 13. | **OXIDATIVE STRESS**<br>- Reactive oxygen and nitrogen species<br>- Mechanisms of oxidative damage to FA and proteins<br>- Antioxidant protection in the body<br>- Natural antioxidants | **NUCLEIC ACIDS II**<br>- exercise: *Detection of nucleic acids components*<br>**3rd REVISION TEST – practical exercises, seminars*** |
| 14. | **MEMBRANES AND TRANSPORT**<br>- Structure of biological membranes - membrane proteins<br>- Transport of substances across biological membrane<br>- Free diffusion, facilitated diffusion<br>- Active transport, group translocation | **EVALUATION OF STUDENTS' WORK**<br>- Final evaluation of practical exercises<br>- Credit donation |

** After writing the revision test, students can view the evaluation of their answers within one week*