

University of Warmia and Mazury in Olsztyn, FACULTY OF MEDICINE, medical program, *Chemistry*, a) LECTURES "L" (15)

No.	Topic	Problems	Hours	Course teacher
1L	Chemical calculations <i>Repetitory course of lectures</i>	a) simple chemical calculations, stoichiometry, b) calculation of acid and base pH, b) solubility constant and solubility - calculations	2.5	Professor Lech Smoczyński LS
2L	Water	Structure of a water molecule, physical and chemical properties, triple point of water. Water solutions – vapor pressure, distillation, boiling-point elevation, freezing-point depression. Conductivity of water solutions, ionic mobility. Osmosis, osmotic pressure, tonicity of solutions. Water balance in the human body.	2.5	LS
3L	Colloids	Definition of the colloidal state, division of colloids. Nanotechnology. Basic colloid preparation methods. Structure of micelles, coagulation – coagulation capacity, coagulants. Electrokinetic phenomena – zeta potential. Ultramicroscopy, nephelometry, turbidimetry. Gels – definition and basic concepts. Sedimentation. ESR – erythrocyte sedimentation rate.	2.5	LS
4L	Structure of organic compounds, mechanism of reaction <i>Repetitory course of lectures</i>	a) structure of organic molecules resulting from sp^3 , sp^2 and sp hybridization, b) mechanism of reactions involving radical and cationic intermediates: free radical halogenations; free radical addition of HX to alkenes; electrophilic addition reactions of alkenes; electrophilic substitution of arenes c) arenes: structure of benzene, aromaticity, resonance, electrophilic substitution, isomerism of polysubstituted aromatic compounds, polycyclic aromatic hydrocarbons	2,5	Dr. Michał Łuczyński ML

5L	Hydrocarbons and isomerism	<p>1. Hydrocarbons – division, chemical properties, nomenclature. Structural isomerism: skeletal isomerism, functional groups isomerism, position isomerism. Stereoisomers (spatial isomers): <i>cis-trans</i> isomerism, <i>Z-E</i> isomerism. Chirality and enantiomerism, the Fischer projection, determination of R-S configuration of a chiral center. Physical and chemical properties of enantiomers. Specific rotation. Diastereoisomers. Molecules with more than one chiral center. Meso compounds. Physical and chemical properties of diastereoisomers. Stereoselectivity of reaction and racemate separation. Biological activity of stereoisomers. Crucial meaning of stereoisomerism in molecule-receptor interaction.</p>	2.5	ML
6L	Major groups of organic compounds	<p>Alcohols and phenols. Alcohol classification and nomenclature. Structure of the hydroxyl group and alcohol properties. Alcohols as weak acids. Alcohols as weak bases – substitution and elimination reactions. Competitive metabolism of methanol and ethanol in human organism Comparison of alcohol and phenol structure. Phenols as weak acids.</p> <p>Aldehydes and ketones. Nomenclature. Structure of the carbonyl group and its influence on the physical properties and the reactivity of aldehydes and ketones. Nucleophilic addition to carbonyl group. Reactivity of α hydrogen atoms; aldol condensation. Redox reactions involving aldehydes and ketones, aldehyde oxidation, Cannizzaro reaction, oxidation of methyl ketones in haloform reactions. Reduction of aldehydes and ketones.</p> <p>Carboxylic acids and their derivatives. Nomenclature. Structure, physical properties and reactivity. Carboxylic acids salts – synthesis and hydrolysis. Factors influencing acid strength. Substitution of the hydroxyl group. Synthesis of carboxylic acids. Carboxylic acid derivatives: structure, classification and reactivity. Use of salicylates in inflammation treatment Nucleophilic substitution to the acyl group – reaction mechanisms. Synthesis, nomenclature and reactions of acid anhydrides, acid chlorides, esters, amides and nitriles. Esterification mechanism.</p> <p>Amines – classification and nomenclature. Reaction order of amines. Aromatic</p>	2.5	ML

		and aliphatic amines. Structure, physical properties and reactivity of amines. Basicity of amines. Amines as nucleophiles. Use of diazonium salts in organic synthesis. Amines as biologically active compounds, opioids, morphine rule.		
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University of Warmia and Mazury in Olsztyn, FACULTY OF MEDICINE

Medical Major, *Chemistry*

b) LABORATORY CLASS "La" (25), SEMINAR "S" (10)

No.	Topic	Problems	Hours	Course teacher
0La	Introductory laboratory	Safety standards in a laboratory. Introduction to basic laboratory equipment and operations.	1	
1La	Chemical equilibrium. Le Chatelier principle. <i>Test 1</i>	The concept of dynamic equilibrium of chemical reaction. Effect of reagents concentration and temperature on the reaction equilibrium. Predicting the course of the reaction after the disturbance of dynamic equilibrium. Le Chatelier principle. Equilibrium constants (K) of dissociation and complexation reactions. Equilibrium of precipitation reactions.	4	
2La	Buffer solutions <i>Test 2</i>	Buffers – types, composition and properties. Buffers of body fluids (carbonate, phosphate, albumin buffer). Preparation of buffer solutions (buffered solution of saline PBS). Determination of buffer capacity. The effect of dilution on the pH of the buffer solution and buffer capacity.	4	
3La	Quantitative determination of protein content using the spectrophotometric method <i>Test 3</i>	Fundamentals of absorption spectrophotometry. Colorimetry. Beer-Lambert law. Molar absorption coefficient. Standard curve (model, calibration curve). Quantitative determination of protein content by the biuret method.	4	
4La	TLC. Aspirin and paracetamol	Thin layer chromatography (TLC). Retention factor. Separation of vegetable dyes by thin layer chromatography. Synthesis of popular pharmaceuticals: aspirin and paracetamol. Estimation of product purity: melting point and thin layer chromatography (TLC). Use of chromatography in laboratory diagnostics	4	

5La	Fats. Amino-acids, proteins. Sugars <i>Test 4</i>	Examination of fat solubility. Basic hydrolysis of fats – saponification. Determination of fat characteristics. Amphoteric properties of amino-acids. Weak acidic properties of amino-acids. Reaction with <i>in situ</i> generated nitrous acid (III) (diazotization). Reaction with copper salts. Reaction with ninhydrin. Millon reaction. Biuret test. Cystine test. Denaturation of proteins. Xanthoproteic test. Molish test. Reducing properties of simple sugars – Tollens and Fehling tests. Selivanov's test. Acidic hydrolysis of sucrose. Enzymatic hydrolysis of sucrose. Polysaccharide reactions with Lugol's iodine. Reactions on which medical laboratory diagnostics are based	4	
6La	Natural products <i>Test 5</i>	Steam distillation and liquid-liquid extraction: clove oil synthesis. Essential oils, steam distillation. Extraction and drying of organic solvent solutions – synthesis and characteristics of clove oil. Isolation of trimiristin from nutmeg – with the use of a Soxhlet extractor. Use of natural sources of biologically active substances in medicine	4	
7S	Organizational matters.	Seminar topics. Assigning topics for papers 1 and 2. Discussing the remaining paper topics. Organizational matters, course requirements.	1	LS
8S	Chemical calculations. Chemistry of free radicals	Paper 1 – Calculation of: a) pH of salt and buffer solution, b) ion activity, c) solubility. Paper 2 – Generation of free radicals. Reactive oxygen species. Hypochlorous acid and its derivatives. Nitrogen oxide and peroxyxynitrite. Organic free radicals. Inactivation of free radicals. Destructive effect of free radicals on cell building substances. Positive influence of free radicals on the body.	2	LS
9S	Chemical kinetics. Electrochemistry	Paper 3 – Molecularity of reaction and reaction order, reaction rate coefficient of first and second order reactions – graphical and mathematical description, half-life (pharmaceutical, radioactive substance), determination of reaction order, the effect of temperature on the reaction rate – the van't Hoff factor and Arrhenius equation, activation energy in selected biochemical processes.	2	LS

		<p>Paper 4 – Redox processes – natural importance, aerobic, anoxic and anaerobic processes (hydrogen sulfide, septicity). Half-cell potential (Nernst potential). Indicator and reference electrodes. Chemical (galvanic) cells and concentration cells. Electrode polarization and overpotential. Amperometric analytical methods. Physicochemistry of respiration in the body.</p>		
10S	<p>Sterane chemistry. Heterocyclic compounds. Carbohydrates</p>	<p>Paper 5 – Steroid nomenclature. Chemical properties. The effect of substituents on chemical properties. Stereochemistry of α- and β-sterane. Structure and properties of cholesterol, cholic acid and bile acids. Steroid hormones (glucosteroids, androgens, estrogens) – synthesis. Cyclopenta[<i>a</i>]phenanthrene.</p> <p>Paper 6 – Heterocyclic compounds of significance for the human body. Vitamins. Nitrogen, oxygen, sulfur and selenium heterocycles.</p> <p>Paper 7 – Structure and physicochemical properties of polysaccharides responsible for structural and energy reserve functions. Biologically significant carbohydrate derivatives: glycosides, homoglycans, heteroglycans. Glycoproteins and proteoglycans.</p>	2	ML
11S	<p>Lipids and biological membranes. Nucleic acids. Eicosanoids</p>	<p>Paper 8 - Lipids. Waxes and fats. Saturated and unsaturated fatty acids: structure, properties and nomenclature. Phospholipids. Glycolipids. Terpenes. Biological membranes – structure and function. Chemical and physical structure of cell membranes. Functions of biological membranes. Different types of transport across membranes. Detectors of smell and taste. Biosensors.</p> <p>Paper 9 – Structure and the physical and chemical properties of nitrogen bases. Structure and biological impact of nucleosides and nucleotides. Structure and properties of nucleic acids. Enzymes and co-enzymes. Genotoxicity. Oxidative metabolism of polycyclic aromatic hydrocarbons (PAHs). Structure-activity correlation of selected organic compounds.</p> <p>Paper 10 – Arachidonic acid – structure, properties, occurrence. Arachidonic acid derivatives formed in the cyclooxygenase pathway (prostaglandins, prostacyclins, thromboxanes) in the lipoxygenase pathway (leucotrienes, lipoxins, hepoxins, trioxylins) and the epoxygenase pathway. Isoprostanes.</p>	2	ML

12S	Course completion	Summary of laboratory classes and proseminars. Course credits granted.	1	LS
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Major references

[1] Moore J.W., Stanitski C.L., Jurs P.C., *Principles of chemistry the molecular science*. Brooks/Cole Cengage learning. US.

[2] McMurry J., *Fundamentals of Organic Chemistry*. Brooks/Cole Cengage learning. US.

[3] Sackheim G.I., Lehman D.D., *Chemistry for the Health Sciences*. Prentice Hall. US.