

Syllabus			
Part A - Description of the subject			
Name of the module/subject	Fundamentals of medical chemistry	Group of detailed education results	
		Group code G	Group name
Faculty	Dentistry		
Major	Dentistry		
Specialization			
Level of studies	uniform MA studies* BA studies MA studies PhD studies Post-graduate studies		
Form of studies	full-time X	part-time	
Year of studies	1st	Semester of studies: winter	
Type of class	Obligatory X	elective	
Kind of class	major-oriented	basic X	
Language of instruction	Polish	English X	other
*choose accordingly by marking with X			
Form of instruction		Hours	
Lecture		10	
Seminar		10	
Tutorial			
Major-oriented class (non-clinical)			
Clinical class			
Laboratory class		15	
Specialization class (MA)			
Simulated conditions class			
Lectorate			
Practical classes with a patient			
Physical education exercises			
Apprenticeship			
Self-study			
Other			
Total		35	
Education aims:			
C1. The transfer of knowledge in the field of structure, properties and functions of the basic chemical components of tissues and body fluids.			
C2. Get to know the basics of chemical homeostasis mechanisms and chemical composition of biological			

	<p>body fluids and present in/on the cells of the human body</p> <ul style="list-style-type: none"> • knows the structure and properties of aminoacids, peptides, proteins, sugars, including glycosaminoglycans, mucins and glycosides, lipids, steroids, nucleic acids • describes the I, II, III and IV-levels of protein structures • knows the importance of posttranslational modification of amino acids • is able to recognize the types of chemical reactions occurring in biological systems 	<p>Test 3: written and oral tests including lectures.</p>	
U 01	<p>The student can</p> <ul style="list-style-type: none"> • make a solution of a given concentration • perform and describe a simple analytical chemical reaction • perform calculations of substance concentrations and solubility of the compounds using tables and formulas • use laboratory equipment, measure the pH of the solution, and evaluate the accuracy of measurements • can perform dilution from the stock solution • draw conclusions and critically interpret the results obtained in the experiment • describe the structure of carbohydrates, proteins, simple and complex 	<p>Presentation, oral response, report, discussion, working with publications, written examination. Assessment of laboratory skills: proper handling of measuring instruments, automatic pipettes analytical scales, centrifuges, and pH-meters. Verification of experimental results and their proper analysis</p> <p>Checking of writing skills of basic chemical structures.</p>	S, C

	lipids, indicating the hydrophilic and hydrophobic parts, components, and the type of bond. • measures pH with pH-meters		
K 01	<ul style="list-style-type: none"> • accepts team work • participates in classes, seminars and lectures • integrates with the group and accepts ethical standards • observe the safety rules 	Assessment of personal and social competence through observation of work and behavior of the student	L, S, C
<p>** L - lecture; S - seminar; T - tutorial; MC - major-oriented classes (non-clinical); CC - clinical classes; LC - laboratory classes; SC – specialization classes (MA); SC - simulated conditions classes; LE - lectorate; P - practical classes with a patient; PE - physical education classes (obligatory); A - apprenticeship; SS - self-study</p>			
<p>Please mark with pluses (scale 1-3) how the abovementioned effects place your module/subject in the sections: passing on knowledge, skills or forming behaviors, e.g.:</p> <p>Knowledge +++ Skills ++ Behaviors +</p>			
Student's work input (ECTS points):			
Type of student's work (participating in class, activity, preparation, tests etc.)		Student's workload (h)	
1. Hours on-site		35	
2. Own work		42	
Summary of the student's workload		77	
ECTS points per module/subject		2	
Remarks			
Subject of class: (enter the topic of each class, including the division for the type of class; remember the topic of class has to translate into intended education results)			
Lectures			
<ol style="list-style-type: none"> 1. The globular proteins. Structure and physicochemical properties. Characteristic properties of domains of globular proteins. Some examples. 2. The fibrillar proteins. Structure and physicochemical properties of collagens and elastin. 3. Conjugated proteins. N-, O-glycoproteins. Mucins. Proteoglycans. Plasma lipoproteins. Peripheral and integral membrane proteins. 4. Structures of some polysaccharides found in nature. Homopolysaccharides: glucans, mannans, galactans, inulin, and chitin. 5. Heteropolysaccharides of the animal body (glucosaminoglycans) and of plants (hemicelluloses, pectins, alginates, heparinoides). The glucuronides. 6. Complex heteroglycans of N- and O- glycoproteins. The oligosaccharides as cell markers: complex glycans of some blood antigens. 7. Complex lipids. Fatty acid with biological activities: Arachidonic acid and its derivatives named 			

eicosanoid compounds. Phospholipids as a major constituents of biological membranes.

8. Lipids as anchors for membrane proteins. Complex structures of animal cell glycolipids and of bacterial cell walls. Steroid hormones. Lipid soluble vitamins.

9. Some steroids. Cholesterol as the most abundant steroid of human body cells.

10. Bile salt family compounds as biological detergents of gastrointestinal tracts.

Seminars

1. Water solution as environment of life. Electrolyte equilibrium in biological fluids. pH and chemical composition of biological fluids (saliva, gastric juice, urine, pancreatic juice, cerebrospinal fluid, blood serum). Micro- and macro- minerals, toxic elements. Simple and serial dilution, strip test, detection of glucose and pH of urine. Calculation and recalculation of concentrations: molar, per-mille, percentage

2. Buffer solution. The buffers of physiological fluids as elements of homeostasis. Buffers: types, composition, and properties. The Henderson-Hasselbach equation for acidic and basic buffers. The definition of buffer capacity, and the effect of strong acids and bases on buffer capacity. Protein, haemoglobin, phosphate, and bicarbonate buffers. The role of blood, lungs, and kidneys in maintaining physiological pH in the human organism. Acidosis and alkalosis. Calculations of pH, pOH and buffer capacities. The preparation of buffer solutions, the determination of buffer capacity by titration of the buffer solution using a strong base and strong acid.

3. Amino acids, peptides and proteins. Peptides with biological activity. Amino acids and proteins - biological fluids (human milk, saliva, plasma, gastric juice). The primary structure of proteins, types of bonds and interactions stabilizing the structure, the isoelectric point, the peptide bond. N- and C- terminal amino acid residues. Determination of the N- and C-terminal residues. The role of disulphide bonds in proteins. Non-protein amino acids, biogenic amines: formation and functions, peptides with biological activity. The damage to the structure of proteins by reactive oxygen species.

4. Saccharides of tissues and body fluids

Isomerization and epimerization of monosaccharides. Structure and reactivity of derivatives of sugars: acyl derivatives, amino sugars, oxidation and reduction products, esters.

Glucuronides and L-ascorbic acid. The aldol condensation reaction and the cleavage of a monosaccharide chain. The destruction of monosaccharide ring of DNA by reactive oxygen species. Monosaccharides of body fluids (human milk, saliva, plasma, seminal plasma, cerebrospinal fluid). The examples of reactions of sugars in the diagnosis of hypo- and hyper-glycemia diagnosis.

5. Lipids of tissues and body fluids

Essential fatty acids (arachidonic acid). Lipids of human, plant and animal from oils, hen egg yolk, milk, plasma and cerebrospinal fluid. Glycerophospholipids: structure, components and bonds. Sterols-cholesterol, bile acids and their salt, and vitamin D. Vitamins soluble in fat (AEDK). Amphipathic properties of phospholipids and sterols. Lipid peroxidation,

antioxidants.

6. Proteins

The physicochemical properties of proteins. Proteins as colloidal solutions. Posttranslational modification of amino acids in proteins. Solubility of proteins (pH, concentration of salt, temperature). Salting in and salting out of proteins.

7. General principle of electrophoresis.

Media used for electrophoresis. The electrophoresis of serum proteins and lipoproteins in agarose. Densitometric analysis. Compare the results of physiological and pathological samples.

Classes – all classes are based on Handbook of chemistry: for students Faculty of Medicine and Faculty of Dentistry; ed. Iwona Katnik-Prastowska; Wrocław: Wrocław Medical University.

1. Dilutions of solutions: simple and serial dilutions. Strip test, detection of glucose and pH of urine. Calculations and recalculations of concentrations.
2. The preparations of buffer solutions, the determination of buffer capacity by titration of the buffer solution using strong base and strong acid.
3. Chemical reactions of amino acids. Acylation of the α -amino group. Reactions of the α -amino group (Schiff's base). Deamination of amino groups (Van Slyke's reaction). Reaction of amino acids with ninhydrin, xanthoproteic reaction, identification of cysteine, the biuret assay. Reaction of a free amino group (Sanger reaction).
4. Partial test nr 1. Calculations of concentrations of substances from chemical solutions and body fluids from classes 1,2,3.
5. Saccharides. Acylation of the glucose, oxidation and reducing disaccharides, condensation and enolization.
6. Lipids. esterification of salicylic acid
Extraction of lipids from hen egg yolk
Oxidation of unsaturated fatty acids
Detection of cholesterol in natural products (Salkowski reaction)
Hay's test with sulphur
Detection of hydroxyl group in bile acids. Pattenkofer's reaction
7. Proteins. Denaturation of proteins. Fractionation of serum proteins with ammonium sulphate. Dialysis. Partial test nr. 2.
8. The electrophoresis of serum proteins and lipoproteins in 1 % agarose, pH = 8.6. Interpretation of results in health and disease.
9. The completion of laboratory classes.
10. Partial test nr. 3 (classes 7 and 8). Final test (includes lecture material).
11. The repetition of final test.

Other----

Basic sources: (list according to significance, no more than 3 items)

1. Handbook of chemistry : for students Faculty of Medicine and Faculty of Dentistry ; ed. Iwona Kałtnik-Prastowska; Wrocław : Wrocław Medical University, 2009 (2012). ISBN 978-83-7055-553-5

2. Chemistry. An Introduction to General, Organic and Biological Chemistry. Timberlake KC, Benjamin

Cummings, Pearson Education, Inc., 2006 USA. ISBN 0-8053-7756-5.

3. Bioanalytical chemistry. Manz A, Pamme N, Iossifidis D, Imperial College Press, 2004 USA. ISBN 1-86094-371-3.

Secondary:

1. Introduction to organic chemistry; WH. Brown; Harcourt Brace and Company, Inc., 2000 USA.

2. Organic Chemistry; G Solomons, C Fryhle; ed JOHN WILEY & SONS, Inc., 2000 USA.

3. Clinical Chemistry: Principles, Procedures, Correlations; ML Bishop, JL Duben-Engelkirk, EP Fody; ed

Lippincott Williams & Wilkins, Inc., 2000 USA

Requirements for teaching resources: (e.g. laboratory, projector, other...)

1. Laboratories with equipment (laboratory tables with plumbing, gas, fume cupboards).

2. Basic equipment used in analytical chemistry (laboratory glassware, scales, mixers, pH-meters,

pipettes, spectrophotometers, electrophoresis units, centrifuges, dryers).

3. Overhead projector, multimedia equipment and a board.

Entry requirements: (the minimum conditions the student has to meet prior to entering the module/class)

The student becomes familiar with the curriculum and teaching regulations of the department and preparing for classes in described in syllabus.

Conditions for completing the course: (what are the terms and conditions of obtaining credits from particular classes within the module/subject, the terms and conditions of being allowed to take the final exam, the terms and conditions for passing the final exam, the requirements for particular grades)

1. Mandatory presence on laboratory classes and seminars. Excused absence is counted in the additional period.

2. Obtaining positive evaluations (60% out of all points) of control tests and final test (includes lectures). Tests are oral or written and the latter have diverse forms: multiple choice, accounts, complement the text, patterns of selected compounds of sugars, fats, amino acid.

3. Students can get extra score for activity and /or laboratory skills.

4. Assessing the appropriateness of a laboratory notebook

Grade:	Grading criteria: (only for subjects/modules ending with an exam)
Very good (5.0)	
Good plus (4.5)	
Good (4.0)	
Sufficiently	

good (3.5)	
Sufficient (3.0)	