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| **Syllabus** |
| **Description of the course** |
| **Module/Course** | Basic of medical chemistry | **Group of detailed education results**  |
| **Group code**B | **Group name**Scientific basis of medicine |
| **Faculty** | Faculty of Dentistry |
| **Major**  | Dentistry |
| **Specialties** |  |
| **Level of studies** | Uniform magister studies X\*1st degree studies 2nd degree studies 3rd degree studies postgraduate studies  |
| **Form of studies** | X full-time part-time |
| **Year of studies**  | 1st | **Semester** | X Winter Summer |
| **Type of course** | X obligatory limited choice free choice / elective  |
| **Course** |  major X basic |
| **Language of instruction** |  Polish X English other |
| \* mark with an **X** |
| **Number of hours** |
| Form of education |
| Unit teaching the course | Lectures (L) | Seminars (SE) | Auditorium classes (AC) | Major Classes – not clinical (MC) | Clinical Classes (CC) | Laboratory Classes (LC) | Classes in Simulated Conditions (CSC) | Practical Classes with Patient (PCP) | Specialist Classes – magister studies (SCM) | Foreign language Course (FLC) | Physical Education obligatory (PE) | Vocational Practice (VP) | Self-Study (Student's own work) | E-learning (EL) |
| **Winter Semester** |
|  | **10** | **10** |  | **15** |  |  |  |  |  |  |  |  | **38** |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Summer Semester** |
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| **TOTAL per year:** |
|  | **10** | **10** |  | **15** |  |  |  |  |  |  |  | **38** |  |
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| **Educational objectives** (max. 6 items)**C1.** The transfer of knowledge in the field of structure, properties, and functions of the basic chemical components of tissues and biological fluids of humans.**C2.** Get to know the basics of chemical homeostasis mechanisms and chemical composition of biological fluids, as a background for further biochemistry and physiopathology teaching.**C3.** Teaching chemical calculations and interpretation of the results obtained from experiments performed.**C4.** Development of appropriate ethical and proper communication skills. |
| **Education result matrix for module/course in relation to verification methods of the intended education result and the type of class** |
| Number of course education result  | Number of major education result  | Student who completes the module/course knows/is able to | Methods of verification of intended education results (forming and summarising) | Form of didactic class*\*\*enter the abbreviation* |
| **W 01** | **B.W1.** | Knows the role of major and trace elements in the process occurring in the body, including the supply, absorption, transport and toxicity | Presentation, oral response | SE, MC |
| **W 02** | **B.W1.** | Describes water and electrolyte equilibrium  | Presentation, oral responseTest 1: written test, calculations, open questions | SE |
| **W 03** | **B.W2.** | Knows and understands the definition of: pH, solubility, isoionic, isohydric, isotonic equilibrium | Presentation, oral responseTest 1: written test, calculations, open questions | SE, MC |
| **W 04** | **B.W2.** | To characterize systemic buffers and understand their importance to homeostasis | Presentation, oral responseTest 1: written test, calculations, open questions | SE, MC |
| **W 05** | **B.W2.** | Is able to define the factors influencing the acid-base balance and characterize oxygen and carbon dioxide transport in the body | Presentation, oral responseTest 1: written test, open questions | SE, MC |
| **W 06** | **B.W4.** | Is able to describe the inorganic and organic components of selected biological fluids including salivaDetermines the pH of body fluids including salivaDescribe the structure and properties of inorganic and organic components in body fluids and present in/on the cells of the human body | Presentation, oral responseTest 2: written test, open questions | L, SE, MC |
| **W 07** | **B.W11.** | Describe the structure and properties of saccharides, polysaccharides, and lipids in/on the cells and extracellular matrix | Presentation, oral responseTest 2: written test, open questions | L, SE, MC |
| **W 08** | **B.W12.** | Describe the structure and properties of amino acids and peptides, and they roles in cell and extracellular matrix  | Presentation, oral responseTest 3: written test, open questions | L, SE, MC |
| **W 09** | **B.W12.** | Describes the I, II, III and IV levels of protein structures | Presentation, oral responseTest 3: written test, open questions | L, SE, MC |
| **W 10** | **B.W10.** | Describe the structure and properties of glycosaminoglycan, glycosides, lipids, steroids, proteins and mucins  | Test 3: written test, open questions | L, SE, MC |
| **W 11** | **B.W12.** | Knows the importance of posttranslational modification of amino acids, amines characterized by the structure | Test 3: written test, open questions | SE, MC |
| **W 12** | **B.W10.** | Is able to recognize the types of chemical reactions occurring in biological systems | Presentation, oral responseTest 3: written test, open questions | L, SE, MC |
| **U 01** | **B.U4.** | Make a solution of a given concentration.Perform calculations of substance concentrations and solubility of the compounds using tables and formulas. | Reports to assess the knowledge of procedures prepared by students (student's workbook) | MC |
| **U 02** | **B.U10.** | Perform and describe a simple analytical chemical reaction | Evaluation and verifications of experimental results | SE, MC |
| **U 04** | **B.U11.** | Use laboratory equipment, measure the pH of the solution, and evaluate the accuracy of measurements | Assessment of teamwork | MC |
| **U 07** | **B.U15.** | Able to critically interpret the results | Assessment of laboratory skills: proper handling of measuring instruments, pH-meters. Verifications of experimental results and their proper analysis. | MC |
| **U 08** | **B.U8.** | Describe the structure of carbohydrates, proteins, simple and complex lipids, indicating the hydrophilic and hydrophobic parts, components, and type of bond |  | L, SE, MC |
| **U 09** | **B.U4.** | Perform calculations of substance concentrations and solubility of the compounds using formulas (percent and molar concentration), calculates the concentration of substances in isotonic solution |  | SE, MC |
| **K 01** | **K.01.** | Accepts team workParticipates in classes, and seminarsIntegrates with the group and accepts ethical standardsObserve the safety rules | Assessment of personal and social competence through observation of work and behaviour of the student | L, SE, MC |
| \*\* L - lecture; SE - seminar; AC – auditorium classes; MC – major classes (non-clinical); CC – clinical classes; LC – laboratory classes; SCM – specialist classes (magister studies); CSC – classes in simulated conditions; FLC – foreign language course; PCP practical classes with patient; PE – physical education (obligatory); VP – vocational practice; SS – self-study, EL – E-learning .  |
| Please mark on scale 1-5 how the above effects place your classes in the following categories: communication of knowledge, skills or forming attitudes:Knowledge: 5Skills: 4Social competences: 3 |
| **Student's amount of work (balance of ECTS points)** |
| **Student's workload** (class participation, activity, preparation, etc.) | **Student Workload (h)****35** |
| 1. Contact hours: | 35 (10 L, 10 SE, 15 MC) |
| 2. Student's own work (self-study): | 38 |
| Total student's workload | 73 |
| **ECTS points for module/course** | 2 |
| Comments  |  |
| **Content of classes** (please enter topic words of specific classes divided into their didactic form and remember how it is translated to intended educational effects) |
| **Lectures****Lectures 5x2 h=10**1. Some important monosaccharides and their derivatives. Structures of some oligosaccharides and glycoproteins as well as of membrane components. Homopolysaccharides: some glucans and galactans.
2. Glycosaminoglycans of animal and plant tissues : heparin, hialuronic acid, heparan sulphate, chondroitin, , dermatan sulphate. Some heteroglycans of plant tissues: pectins and heparinoids. Some glucuronides of plant tissues with pharmacologic activities. Examples of glucosides of animal tissues and their biological significance.
3. Complex membrane lipids and body fluids. Fatty acids of biological activities. Arachidonic acid and its derivatives (eicosanoids). Phospholipids as a main component of biological membranes. Glycerophospholipids: phosphatidylcholine, phosphatidylserine, phosphatidylethanolamine, phosphatidylinositol, plasminogen. Sphingolipids: cerebrosides, globosides, gangliosides. The structures of glycolipids of bacterial cells: lipopolisaccharides. Steroids, structure and biological functions. Cholesterol. Bile salts structures and their action.
4. The structure and properties of some fibrillar proteins. Collagens, elastin and fibronectin of extracellular matrix. The structure and physicochemical properties of globular proteins. Domains of proteins and their main types as the base of protein classification. Some examples of structures of domain proteins. The general structure of mosaic proteins.
5. Structures of conjugated proteins. N- and O-glycoproteins, mucins and proteoglycans. Oligosaccharides of blood group ABO and Lewis antigens. General structure of plasma lipoproteins. The peripherals, integral and GPI-anchored proteins. Structures of the bacterial cell wall peptidoglycans.
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| **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, toxicity elements. Simple and serial dilution.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.3. **Amino acids 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 residue. 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. N- and O-glycoside bonds in oligosaccharides. The destruction of monosaccharide ring in DNA by reactive oxygen species. Monosaccharides of body fluids (human milk, saliva, plasma, cerebrospinal fluid). The examples of reactions of sugars in the diagnosis of hypo and hyperglycemia.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. Esters and amide with alcohols and amino alcohols (aspirin). Glycerophospholipids: structure, components and bonds. Sterols-cholesterol, bile salt, acids and vitamin D. Vitamins soluble in fat (AEDK). Amphipathic properties of phospholipids and sterols. The basic structure of lipoprotein. Lipid peroxidation, antioxidants.6. **The physicochemical properties of proteins**. The I, II, II, and IV structures of proteins, kind of bonds, and forces stabilising the structures. Isoelectric point of proteins. Posttranslational modification of amino acids in proteins (acetylation, hydroxylation, phosphorylation, methylation, and carboxylation). Proteins as colloidal solutions. Solubility of proteins (pH, concentration of salt, temperature). Salting in and salting out of proteins. Osmosis, tonicity and Gibbs-Donnan equilibrium, dialysis –principle and applications. Denaturation and coagulation of proteins with chemical agents.7. **General principle of electrophoresis.** Media used for electrophoresis. The electrophoresis of serum proteins and lipoproteins in agarose. Densitometry analysis. The electrophoresis of nucleic acids. Capillary electrophoresis, isoelectric focusing. |
| **Practical classes****Classes**All classes are based on Handbook of chemistry: for students Faculty of Medicine and Faculty of Dentistry; ed. Iwona Kątnik-Prastowska; Wrocław 2015**1. Dilutions of solution**: simple and seral dilutions. Strip test, detection of glucose and pH of urine. Calculations and recalculations of concentrations.**2. The preparation of buffer solutions**, the determination of buffer capacity by titration of the buffer solution using a strong base and strong acid. Calculation of pH of buffer and buffer capacities.**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.** **Repetition and supplement program content from the previous Exercise (1-3)**Partial test no 1. Calculations of concentrations of substances from chemical solutions and body fluids from classes 1, 2 ,3.**5. Saccharides.** Synthesis of alpha-glucose pent acetate. Oxidation of saccharides. Reduction of picric acid. Differentiating monosaccharides and reducing disaccharides – Barfoed’s test. Detection of monosaccharides – Molisch reaction. Condensation betwen phenylhydrazine and a monosaccharides - identification of monosaccharides. Eenolization (Seliwanoff reaction). Sucrose hydrolysis - stability of the O-glyosidic linkage.**6. Lipids**. Esterification of salicylic acid. Extraction of lipids from hen egg yolk. Hydrolysis of lecithin 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**. Fractionation of serum proteins with ammonium sulphate. Dialysis. Denaturation of proteins. The partial test 2 (sugars and lipids).**8. The electrophoresis of serum proteins an lipoproteins in agarose.** Densitometry analysis. Compare the results of physiological and pathological samples. **9. The completion of laboratory classes.****10. Partial test no 3** (classes 7 and 8). **11. The repetition of tests 1-3.** **Final test (includes lecture material).** |
| **Other**1. Not applicable
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| **Basic literature** (list according to importance, no more than 3 items)Chemistry. An Introduction to General, Organic and Biological Chemistry. Timberlake KC, Benjamin Cummings, Pearson Education, Inc., 20152. Handbook of chemistry: for students Faculty of Medicine and Faculty of Dentistry; ed. Iwona Kątnik-Prastowska; Wroclaw: Wroclaw Medical University, 20153. Bioanalytical chemistry. Manz A, Pamme N, Ossifidis D, Imperial Colleg Press, 2004 USA. ISBN 1-86094-371-3**Additional literature and other materials** (no more than 3 items)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 USA3. Clinical chemistry: Principles, Procedures, Correlations; ML Bishop, JL Duben-Engelkirk, EP Fody; ed Lippincott Williams and Wilkins, Inc., 2000 USA |
| **Didactic resources requirements** (e.g. laboratory, multimedia projector, other…)1. Chemical laboratory equipment2. Overhead projector |
| **Preliminary conditions** (minimum requirements to be met by the student before starting the module/course)Knowledge of high school chemistry |
| **Conditions to receive credit for the course** (specify the form and conditions of receiving credit for classes included in the module/course, admission terms to final theoretical or practical examination, its form and requirements to be med by the student to pass it and criteria for specific 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. The final test is considered to be included after obtaining 60% points from the total pool of points.4. Each question has a final test measurement point. |
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| **Grade:** | **Criteria** (only for courses/modules ending with an examination) |
| Very Good(5.0) | Not applicable |
| Good Plus (4.5) | Not applicable |
| Good(4.0) | Not applicable |
| Satisfactory Plus (3.5) | Not applicable |
| Satisfactory (3.0) | Not applicable |
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| **Name and address of module/course teaching unit, contact: telephone and e-mail address**Department of Chemistry and Immunochemistry, Wrocław Medical University, ul. Bujwida 44a;tel.: 71 328 26 95, tel/faks: 71 328 16 49;e-mail:maria.katnik-prastowska@umed.wroc.pl**Coordinator / Person responsible for module/course, contact: telephone and e-mail address**Prof. dr hab. Maria Iwona Kątnik-Prastowskatel.: 71 328 26 95, tel/faks: 71 328 16 49;e-mail:maria.katnik-prastowska@umed.wroc.pl**List of persons conducting specific classes: full name, degree/scientific or professional title, discipline, performed profession, form of classes**.Lectures: Prof. dr hab. M. Iwona Kątnik-PrastowskaDr hab. Ewa M. Kratz, adiunktSeminars and Major Classes:1. Dr hab. Magdalena – Orczyk Pawiłowicz2. Mgr Jolanta Lis-Kuberka, asystent

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| **Date of Syllabus development**  | **Syllabus developed by**  |
| 23.06.2016 | Dr Anna Lemańska-Perek |
| **Signature of Head of teaching unit** |
| ……………....……………………………………………………………… |

**Signature of Faculty Dean**  |
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