UNIWERSYTET MEDYCZNY
IM. PIASTÓW ŚLĄSKICH WE WROCŁAWIU

Appendix No.3
to Resolution No. 2303
of Senate of Wroclaw Medical University
of 28 April 2021

Syllabus for academic year: 2021/2022
Training cycle: 2021/2022 - 2026/2027

Description of the course

Course	Biochemistry with elements of chemistry (1)	Group of detailed education results: Group code B	Group name SCIENTIFIC BASES OF MEDICINE
Faculty	Faculty of Medicine		
Major	Medicine		
Level of studies	X uniform magister studies ☐ 1st degree studies ☐ 2nd degree studies ☐ 3rd degree studies ☐ postgraduate studies		
Form of studies	X full-time ☐ part-time		
Year of studies	I	Semester:	x winter x summer
Type of course	x obligatory ☐ limited choice ☐ free choice / optional		
Language of study	☐ Polish X English		

Number of hours

Form of education

	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)	Foreign language Course (FLC)	Physical Education (PE)	Vocational Practice (VP)	Directed Self-Study (DSS)	E-learning (EL)
Winter semester: 40 hours													
Department of Biochemistry and Immunochemistry													
Direct (contact) education[1]						27							
Distance learning[2]	13												
Summer semester: 60 hours													
Department of Biochemistry and Immunochemistry													
Direct (contact) education		10				40							
Distance learning	10												

[1] Education conducted with direct participation of university teachers or other academics
[2] Education with applied methods and techniques for distance learning

TOTAL per year: 100 hours													
Department of Biochemistry and Immunochemistry													
Direct (contact) education		10				67							
Distance learning	23												

Educational objectives (max. 6 items)

C1. Provide the students with the knowledge on the structure, properties, function and metabolic processes of the basic groups of chemical compounds in norm and pathology

C2. Equip the students with the abilities of performing biochemical calculations and of interpretation of the results of conducted experiments

C3. Familiarize students with the basic scientific techniques applied in biomedical studies

C4. Creation of biochemical foundations enabling the students to gain in-depth understanding of molecular mechanisms underlying various disorders, important in subsequent stages of medical education as well as in a future professional career as medical doctor.

C5. Shaping attitudes promoting scientific reliability, by stressing the importance of precision and repeatability of laboratory measurements as well as diligence in biochemical calculations and development of efficiency and manual precision as aptitudes and abilities necessary during the work in students laboratory as well as in a future professional career as medical doctor.

C6. Development social competences needed to practice the medical profession, in accordance with graduate's profile.

Education result for course in relation to verification methods of the intended education result and the type of class:

Number of detailed education result	Student who completes the course knows/is able to	Methods of verification of intended education results	Form of didactic class **enter the abbreviation*
B.W.1	Knows and understands the water-mineral balance of biological systems	Written exams in a form of MCQ, MRQ tests, a choice of yes/no answers, matching answers, with open questions Standardized oral exams focused on the evaluation of knowledge on the level of understanding, analysis, synthesis,	LE, SE, LC
B.W.2	Knows and understands the acid-base balance and the mechanism of action of buffers and their importance in body homeostasis		LE, SE, LC
B.W.3	Knows and understands the terms: solubility, osmotic pressure, isotonia, colloidal solutions and Gibbs-Donnan effect		LE, SE, LC
B.W.4	Knows and understands the basic reactions of inorganic and organic compounds in aqueous solutions		LE, SE, LC
B.W.10	Knows and understands the structure of simple organic compounds that make up the macromolecules present in cells, the extracellular matrix and body fluids		LE, SE, LC
B.W.11	Knows and understands the structure of lipids and polysaccharides and their functions in cellular and extracellular structures		LE, SE, LC
B.W.12	Knows and understands the I-, II-, III- and IV-order structures of proteins and post-translational and functional modifications of proteins and their significance		LE, SE, LC
B.W.13	Knows and understands the function of nucleotides in the cell, the I- and II-order structures of DNA and RNA, and the structure of chromatin		LE, SE, LC
B.W.14	**Knows and understands** the functions of the human genome, transcriptome and **proteome and the principal methods used to study them, the processes** of DNA replication, repair and recombination, transcription and translation and the **degradation of** DNA, RNA and **proteins**, and the concepts of regulation of gene expression		LE, SE, LC

B.W.15	Knows and understands the basic catabolic and anabolic pathways, how they are regulated, and how they are influenced by genetic and environmental factors	problem solving. Written tests in a form of short essays, reports, short structured questions	LE, SE, LC
B.W.16	Knows and understands the metabolic profiles of key organs and systems		LE, SE, LC
B.W.17	Knows and understands the ways in which cells communicate with each other and with the extracellular matrix, and the pathways for transmitting signals within the cell, and examples of disruption of these processes leading to cancer and other diseases		LE, SE, LC
B.W.18	Knows and understands the processes: cell cycle, proliferation, differentiation and ageing of cells, apoptosis and necrosis and their significance for the functioning of an organism		LE, SE, LC
B.W.20	**Knows and understands** . the basics of stimulation and conduction in the nervous system and higher nervous functions, as well as striated and smooth muscle physiology and **blood functions**		LE, SE, LC
B.W.23	Knows and understands . the body's ageing mechanism		LE, SE, LC
B.W.25	Knows and understands the relationship between factors disturbing the equilibrium state of biological processes and physiological and pathophysiological changes		LE, SE, LC
B.W.29	Knows and understands the principles of scientific, observational and experimental research and *in vitro* studies for the development of medicine		LE, SE, LC
B.U.3	Is able to calculate the molar and percentage concentrations of compounds and the concentrations of substances in iso-osmotic, mono- and multi-component solutions	Direct observation and evaluation of the student's manual performance, his abilities to solve problems, and abilities to prepare and present presentations on the indicated scientific topics	LC
B.U.4	Is able to calculate the solubility of inorganic compounds, determine the chemical basis of the solubility or lack thereof of organic compounds and its practical significance for dietetics and therapeutics		LC
B.U.5	Is able to determine the pH of a solution and the effect of changes in pH on inorganic and organic compounds		LC
B.U.6	Is able to predict the direction of biochemical processes in relation to the energy state of cells		LC
B.U.8	**Is able to use basic laboratory techniques such as qualitative analysis, titration, colorimetry, pH monitoring, chromatography, electrophoresis of proteins** and nucleic acids		LC
B.U.9	Is able to operate simple measuring instruments and assess the accuracy of the taken measurements		LC
B.U.10	Is able to use databases, including online databases, and search for required information using the available tools		LC
B.U.13	Is able to plan and carry out simple scientific research, interpret the results and draw conclusions from them		LC

* L- lecture; SE- seminar; AC- auditorium classes; MC- major classes (non-clinical); CC- clinical classes; LC- laboratory classes; CSC- classes in simulated conditions; PCP- practical classes with patient; FLC- foreign language course; PE- physical education; VP- vocational practice; DSS- directed self-study; EL- E-learning

Student's amount of work (balance of ECTS points):

Student's workload (class participation, activity, preparation, etc.)	Student Workload
1. Number of hours of direct contact:	100
2. Number of hours of distance learning:	23
3. Number of hours of student's own work:	54,3
4. Number of hours of directed self-study	n/d
Total student's workload	154,3
ECTS points for course	7

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

1. ACID-BASE BALANCE OF THE ORGANISM AND BUFFER SYSTEMS (1x45 min)

Mechanism of buffer systems function. Acid-base balance in a human organism. Bicarbonate buffer, acidosis and alkalosis. Hemoglobin buffer – the role in gas exchange in the lungs and kidneys. Globular proteins as buffers. Phosphate buffer – the role in kidneys' reabsorption.

2. CARBOHYDRATES (1x45 min)

Properties and classification of sugars. Polysaccharides as dietary fiber – the significance of their structure for a healthy microbiome. Oligosaccharides of human milk and their immunomodulating significance. Heparin and hyaluronic acid – examples of functional glycosaminoglycans. Glucuronides in detoxification processes. Cardiac glycosides – structure.

3, 4. LIPIDS AND LIPIDS-LIKE COMPOUNDS (2x45 min)

Properties of the storage and biological membranes lipids. The role of unsaturated fatty acids and cholesterol for biological membrane fluidity and formation of lipid rafts. Cholesterol derivatives: steroid hormones, amphipathic character of bile acids. Immunomodulatory eicosanoids (prostaglandins, leukotrienes, thromboxanes and prostacyclins). Lipid second messengers (DAG, IP3, ceramide).

5. EXAMPLES OF HETEROCYCLIC COMPOUNDS (1x45 min)

Tautomerism of nitrogenous bases as a mechanism of point mutations. Porphyrins: heme, bile pigments. Examples of vitamins and coenzymes. Nucleotides – the role in cell energetics, signal transduction and metabolism.

6. AMINO ACIDS: SUBSTRATES FOR PROTEIN SYNTHESIS (1x45 min)

Overview of amino acids present in proteins, ionic properties, significance of side chains for protein properties. Non-protein amino acids: GABA, taurine, urea cycle amino acids. Biogenic amines as biologically active compounds: histamine, catecholamines, serotonin, melatonin, putrescine, spermine, spermidine, cadaverine.

7, 8. PEPTIDES AND PROTEINS – part I (2x45 min)

Peptide bond and primary structure of proteins. Biologically active peptides: glutathione and peptide hormones – thyroliberin, oxytocin, vasopressin, insulin, glucagon, angiotensin I and II. Enkephalins and endorphins. Secondary and tertiary structure of proteins – chemical bonds and forces stabilizing structure, architecture of molecules. Quaternary structure of proteins on the example of hemoglobin – Bohr effect. Hemoglobinopathies. Physico-chemical properties of proteins and the role of globular proteins (hemoglobin, myoglobin, serum proteins, antibodies, growth factors and cytokines). Protein hormones (leptin, adiponectin, growth hormone). Proproteins (prointerleukins, angiotensinogen, proinsulin, proopiomelanocortin).

9, 10. PEPTIDES AND PROTEINS – part II (2x45 min)

Fibrous proteins (fibrillar) and extracellular matrix structure. Collagen, keratin, elastin – connections between structure and function. Integral and peripheral biological membrane proteins. The modes of anchoring to biological membranes, connections between structure and function, communication between cell and extracellular environment. Post-translational modifications of proteins – from translation to functional molecule. Quality control in protein synthesis: chaperones, folding quality control, protein conformational diseases (Alzheimer, Parkinson, Huntington, prion diseases).

11. GLYCOCONJUGATES (1x45 min)

Glycoproteins and gangliosides – the role in intercellular communication. Blood groups antigens. Leukocyte extravasation in inflammatory processes as an example of regulatory protein-carbohydrate interaction. Congenital glycosylation deficiencies – psychomotor development disorders. Glycosoaminoglycans and proteoglycans – structure and function of extracellular matrix. Involvement of proteoglycans in signal transduction. Bacterial glycoconjugates – peptidoglycan and lipopolysaccharides and strains invasiveness.

12, 13. THE ROLE OF ENZYMES IN MAINTENANCE OF HOMEOSTASIS AND IN CLINICAL PRACTICE (2x45 min)

Enzymes as metabolism regulators. Medications as factors modulating enzymatic activity. Enzymes as disease markers. Enzymes as therapeutic targets, medications and in gene therapy. Multifunctionality of enzymes.

14. METABOLISM OF INFORMATION (1x45 min)

Signal transduction cascade (ligand-receptor-adaptor proteins- second messengers-tyrosine-threonine and serine kinases – transcription factors). Protein kinases as therapeutic targets. Biochemical diversity of responses to cellular stress (autophagy, apoptosis, necrosis).

15 – 21 METABOLISM OF LIPIDS AND CARBOHYDRATES – THE ROLE IN CARDIOMETABOLIC DISEASES PATHOGENESIS

15, 16. LIPID METABOLISM (2x45 min)

Digestion, absorption and transport of lipids in the blood and through the cellular membrane – the role of plasma lipoproteins and fatty acids binding proteins (FABP). Catabolism of lipids as a source of energy. Lipids as a storage material. Ectopic degradation of fat – non-alcoholic fatty liver disease, lipotoxicity as a cause of kidneys, heart and skeletal muscles dysfunction. Adipose tissue as endocrine organ. Leptin resistance. Lipid metabolism control by PPAR receptors – pharmacological potential in the treatment of obesity, diabetes, inflammatory state, neurodegenerative diseases. Ketone bodies as alternative energy source and clinical manifestation of type I diabetes. Cholesterol biosynthesis and biomedical significance (vitamin D, steroid hormones, bile acids). The role of cyclooxygenase (COX) and its inhibitors (non-steroidal anti-inflammatory drugs) in eicosanoids metabolism. The role of dyslipidemia and the significance of lipoprotein in cardiovascular diseases pathogenesis.

17, 18. 19 CARBOHYDRATE METABOLISM (3x45 min)

Digestion, absorption and transport of carbohydrates – glucose transporters as therapeutic targets. Main pathways of glucose metabolism- disturbances.Glucose-6-phosphate dehydrogenase (G6PD) deficiency as the most frequently occurring enzymopathy – pharmacological implications. The significance of polyol pathway in pathogenesis of diabetes complications. Synthesis of amino sugars – connections between extracellular matrix remodeling and cardiac insufficiency. The fates of pyruvate and ethanol metabolism (auto-brewery syndrome; the role of alcohol and aldehyde dehydrogenases polymorphism and influence of medications on the rate of ethanol detoxification). Glucose isomers metabolism – biomedical significance (fructosemia and galactosemia, the significance of fructose in hyperuricemia and hypertension as well as carcinogenesis). Tissue divergence of carbohydrate metabolism.

20, 21. LIPID AND CARBOHYDRATE METABOLISM DISTURBANCES – CARDIOMETABOLIC DISEASES (2x45 min)

Hormonal integration of lipid and carbohydrate metabolism (insulin, glucagon, epinephrine, cortisol, prolactin, growth hormone, thyroid hormones, leptin, adiponectin). State of satiety - state of starvation cycle. Molecular background of obesity, insulin resistance, diabetes and metabolic syndrome. Metabolic disturbances as risk factors of cardiovascular diseases. Biochemical aspect of action of drugs regulating lipid-carbohydrate metabolism.

22, 23. ENERGETICS OF THE CELL. BIOLOGICAL OXIDATION AND OXIDATIVE STRESS (2x45 min)

The fate of the end products of lipid and carbohydrate metabolism in terms of obtaining energy. Comparison of energetic yields of complete oxidation of fatty acids and glucose – why cancer cells prefer glucose? Transport of reducing equivalents between cytosol and mitochondrium. Respiratory chain and ATP synthesis – respiratory chain as a main source of free radicals, Antibiotics, salicylates and poisons as inhibitors or uncoupling agents of respiratory chain. Microsomal oxidation. Reactive oxygen and nitrogen species. Anti-oxidant defense of the organism. Oxidative stress in aging of organism and molecular background of diseases on the example of arthritis, inflammatory bowel diseases, post-ischemic reperfusion injury, atherosclerosis, neoplasms and organ insufficiency caused by sepsis.

Seminars

1. SEMINAR I

Organizational classes. Introduction to biochemistry, Kinetic parameters of enzymatic reaction – determination of Km and Vmax, examples and biomedical application. Effect of environmental conditions on enzymatic reaction velocity (pH, temperature, enzyme concentration). Types of inhibition – biomedical significance of inhibitors.

2. SEMINAR II

Allosteric enzymes. Isoenzymes – diagnostic significance. Proenzymes – the role in prevention of auto-digestion of tissues on the example of digestive enzymes and in prevention of uncontrolled clotting on the example of blood coagulation cascade enzymes.

3. SEMINAR III

Digestion and absorption of lipids. Digestion of triacylglycerols – the role of hormone-sensitive lipase. Oxidation of fatty acids as the main source of energy for skeletal muscles at rest and heart muscle – disturbances (FAOD – fatty acid oxidation disorders). The role of carnitine in fatty acids transport between cytoplasm and mitochondrium – disturbances and importance of carnitine supplementation in the diet.

4. SEMINAR IV

Fatty acids synthesis – the course and the disturbances. Triacylglycerols synthesis – the course and disturbances. Synthesis and biomedical significance of ketone bodies. Cholesterol biosynthesis – the role of statins and phytosterols in the reduction of cholesterol level and atherosclerosis prevention.

5. SEMINAR V

Cholesterol derivatives – vitamin D. Cholesterol derivatives – steroid hormones and bile acids. Glycolysis – the role, course and disturbances – deficits of glycolytic enzymes as the cause of hemolytic anemia.

6. SEMINAR VI

Intensification of anaerobic glycolysis accompanied by oxidative phosphorylation in cancer cells – application of Warburg effect in the diagnostics of neoplastic diseases using positron emission tomography (PET). Gluconeogenesis – the role, pathway, disturbances – involvement in insulin resistance induced obesity. Cori and alanine cycle – the role and course.

7. SEMINAR VII

Synthesis and degradation of glycogen – role, course, organ diversity and disturbances (glycogen storage diseases). Hormonal regulation of glycogen metabolism – the impact of insulin resistance on glycogen metabolism. Modulation of glycogen metabolism as lithium mechanism of action in bipolar affective disorder and lithium and metformin in cancers.

8. SEMINAR VIII

Pentose phosphate pathway – the role, course, regulation and disturbances; significance in obesity, diabetes and carcinogenesis. Alternative sources and the role of NADPH in the cell. Galactose metabolism – course and disturbances (galactosemia) and the role in organism aging processes as well as in the cognitive functions disorders.

9. SEMINAR IX

Fructose metabolism – the course and disturbances (fructosemia) and its role in obesity, metabolic syndrome and diabetes. Hormonal integration of metabolism – the role of glucagon and epinephrine.

10. SEMINAR X

Hormonal integration of metabolism – the role of insulin, the effects of insulin deficiency (type 1 diabetes) as well as hyperinsulinemia and insulin resistance (type 2 diabetes). Carbohydrate metabolism depending on the energetic status of the organism.

Classes

LABORATORY I

Principles of the work in a laboratory and safety instructions. Solutions.

Biomedical significance: preparation of solutions with an indicated concentration; conversions of concentrations; tonicity; electrolyte equilibrium; isovolemia; isoionia; isohydria; micro and macro minerals; differences in biological fluids composition.

LABORATORY II

Systemic buffers. Blood pH.

Biomedical significance: buffer solutions; calculation of pH and buffer capacity, acidosis, alkalosis

LABORATORY III

Qualitative analysis of mono- and disaccharides.

Biomedical significance: milk free oligosaccharides in infants nutrition; lysosomal storage diseases of carbohydrates and glycosides.

LABORATORY IV

Detection and properties of lipids and sterols.

Biomedical significance: significance of unsaturated fatty acids in the diet – omega-3 and omega-6 fatty acids; systemic lipids transport .

LABORATORY V

Qualitative analysis of amino acids, TLC chromatography. Analysis of amino acid composition in a peptide and protein.
Biomedical significance: correlation between amino acid composition and properties and functions of proteins; significance of free thiol groups for anti-oxidative potential; free amino acids (FAA) in human milk; protein in a diet; non-essential amino acids; conditionally non-essential amino acids and essential amino acids; therapeutic aspect vs. negative effects of elimination diets; malnutrition.

LABORATORY VI

Physicochemical properties of globular proteins. Proteins as colloidal solutions; Gibbs-Donnan equilibrium. Plasma proteins fractions: composition, functions, properties. Coagulation. Salting out. Dialysis. Protein denaturation – the manners of protein structure disruptions.
Biomedical significance: hypoalbuminemia, implications of Gibbs-Donnan equilibrium: red blood cell pH, medications absorption; principles of dialysis in kidneys insufficiency.

LABORATORY VII

Electrophoretic analysis of biological fluids composition.
Biomedical significance: Physiological and pathological electrophoretical pattern of serum proteins. Densitometric analysis of fractions. Electrophoretic pattern of serum lipoproteins.

LABORATORY VIII

Determination of protein content in biological material using biuret method. Registration of protein spectrum (hemoglobin) and nucleic acid in UV/VIS spectrum.
Biomedical significance: application of UV/VIS spectrometry in diagnostics.

LABORATORY IX

Principles of chromatography of proteins. Desalting of proteins.

LABORATORY X

Recapitulation of classes 1-9: detection of the main groups of compounds in the organism, comparison of chemical properties. Make-up/repetition of classes

LABORATORY XI

Measurement error. – evaluation of reliability of experimental results.
Biomedical significance: precision of measurements in biochemical and medical practice; the tools for evaluation of results/tests reliability – inter- and intra-group variation.

LABORATORY XII

Preparation of standard curves.
Biomedical significance: colorymetry and turbidimetry in quantatitive analysis of macromolecules – application in diagnostic tests, i.e. as colorimetric biosensors in point-of-care tests, in a high-throughput screening studies of medicinal drugs and in the control of food sterility.

LABORATORY XIII

Kinetics of enzymatic reaction, part I: Km and Vmax determination.

LABORATORY XIV

Kinetics of enzymatic reaction, part II: effects of inhibitors on reaction course and determination of inhibition constants (Ki)

LABORATORY XV

Kinetics of enzymatic reaction, part III: effect of environmental conditions on reaction course.
Biomedical significance: medicinal drugs as enzymatic activity modulators; significance of KM and Ki for determination of the drug dosage; prediction of enzymes efficiency; substrate specificity of enzymes; substrate inhibition – a role in metabolism regulation; effect of elevated or decreased body temperature on enzymatic activity and metabolism; effect of acidosis and alkalosis on enzymatic activity and metabolism.

LABORATORY XVI

Evaluation of concentrations of fibrinogen, albumin, transferrin and ceruloplasmin in systemic fluids
Biomedical significance: proteins as mediators of inflammatory state; quantitative analysis of acute phase proteins as a diagnostic tool.

LABORATORY XVII

Determination of activity of aspartate aminotransferase (AspAT) and γ-glutamyl transferase (GGT) in biological fluids.

Biomedical significance: enzymes as markers of pathological states; significance of aminotransferases in diagnostics of liver and heart diseases; significance of transamination reaction as a protecting mechanism against ammonia toxicity.

LABORATORY XVIII

Glycogen degradation

Biomedical significance: polysaccharides as a storage material; the significance of glycogen as energy source and its role in the maintenance of a steady concentration of blood glucose; tissue diversity of glycogen metabolism (muscles vs. liver).

LABORATORY XIX

Determination of triacylglycerol and total cholesterol as well as HDL- and LDL-cholesterol concentrations. Quantitative and qualitative analysis of LDL lipoproteins (estimation of lipid-protein profile).

Biomedical significance: physiological and atherogenic profile of lipids; the role of lipoproteins in lipid transport; cholesterol as a component of biological membranes and a precursor of biologically active compounds (vitamin D, steroid hormones, bile acids); diagnostic and clinical significance of cholesterol, triacyglycerols and lipoproteins (dyslipidemias, apolipoproteinemias and cardiovascular diseases).

LABORATORY XX

Evaluation of malondialdehyde (MDA) concentration and paraoxonase (PON) as well as peroxidase activities in body fluids.

Biomedical significance: oxidative stress in pathogenesis of diseases; diagnostic potential of oxidative modification of macromolecules on the example of lipid peroxidation; organism's anti-oxidative defense; effect of polymorphism on enzyme phenotype and the two-substrate method for determination of the enzyme phenotype on the example of paraoxonase..

Other
consultations

Basic literature (list according to importance, no more than 3 items)

1. Richard A. Harvey et al. "Lippincot's Illustrated Reviews: Biochemistry" VIII Edition, 2021; ISBN-13: 978-1975155063 ; ISBN-10: 1975155068
2. Robert K. Murray et al. "Harper's Biochemistry"31st edition; 2018; ISBN10 1259837939l; ISBN13 9781259837937

Additional literature and other materials (no more than 3 items)

1. Thomas M. Devlin „Biochemistry with Clinical Correlations", 7th edition; Willey-Liss, New York; ISBN: 978-0-470-28173-4
2. L. Baynes., M. Dominiczak, „Medical Biochemistry", Mosby Elsevier, 5th Edition, 2018; ISBN: 9780702072994 ; eBook ISBN: 9780702073007

Preliminary conditions: (minimum requirements to be met by the student before starting the course)

The student should know the fundamentals of chemistry and biology at the high school level

Conditions to receive credit for the course: (specify the form and conditions of receiving credit for classes included in the course, admission terms to final theoretical or practical examination, its form and requirements to be met by the student to pass it and criteria for specific grades)

Attention! Attendance can not be a condition for passing the course

1. Proper execution of laboratory classes and preparation of reports summarizing the obtained data, correct calculations and conclusions from the conducted experiments – classes are planned in direct contact (however, their mode may change with respect to epidemiologic situation)
2. Active participation in seminar classes – analysis and solving scientific problems and involvement in preparation of presentations and active participation in discussion experiments – classes are planned in direct contact (however, their mode may change with respect to epidemiologic situation)
3. Obtaining positive grades from all tests scheduled in a course, above 60% of points possible to obtain (test form: written, form: MCQ, MRQ tests, a choice of yes/no answers, matching answers, open questions).
4. Semestral grade is based on the sum of points obtained from particular tests. The detailed criteria of the grading system are presented in the table below.

5. Each absence must be made up by a student in a manner indicated by a person supervising the classes in agreement with a person responsible for the subject.
6. Tests and exams are conducted either in the direct contact with a teacher or using electronic communication media

Grade:	Criteria for courses ending with a grade[3]
Very Good (5.0)	≥ 93% of maximal number of points obtained from the tests
Good Above (4.5)	≥ 85% of maximal number of points obtained from the tests
Good (4.0)	≥ 77% of maximal number of points obtained from the tests
Satisfactory Plus (3.5)	≥ 69% of maximal number of points obtained from the tests
Satisfactory (3.0)	> 60% of maximal number of points obtained from the tests

Department in charge of the course:	Department of Biochemistry and Immunochemistry
Department address:	Department of Medical Biochemistry Chałubińskiego 10, 50-368 Wrocław Department of Chemistry and Immunochemistry M. Skłodowskiej-Curie 48/50, 50-369 Wrocław
Telephone:	**71 784 13 70** (Department of Medical Biochemistry) **71 770 30 31** (Department of Chemistry and Immunochemistry)
E-Mail:	WL-41@umed.wroc.pl

Person in charge for the course:	Dr hab Małgorzata Matusiewicz
Telephone:	71 784 13 96; 71 784 13 70
E-Mail:	malgorzata.matusiewicz@umed.wroc.pl

List of persons conducting specific classes:

Name and surname	Degree/scientific or professional title	Discipline	Performed profession	Form of classes
Małgorzata Krzystek-Korpacka	Prof. dr hab. of Med. Sci.	Medical sciences	Academic teacher, biochemist	SE, LC
Magdalena Orczyk-Pawiłowicz	**Dr. hab.** of Med. Sci., **WMU prof.**	Medical sciences	Academic teacher, biochemist	SE, LC
Mirosława Ferens-Sieczkowska	**Dr. hab.** of Med. Sci., **WMU prof.**	Medical sciences	Academic teacher, biochemist	L, SE, LC
Małgorzata Matusiewicz	Dr hab. of Med. Sci.,	Medical sciences	Academic teacher, biochemist	L, SE, LC
Iwona Bednarz-Misa	Dr. of Med. Sci., specialist in medical laboratory diagnostics	Medical sciences	Academic teacher, laboratory diagnostician, biochemist	SE, LC
Izabela Berdowska	Dr. of Med. Sci.,	Medical sciences	Academic teacher, biochemist	L, SE, LC
Mariusz Bromke	Dr. of Natural Sci.	Medical sciences	Academic teacher, biochemist	SE, LC
Agnieszka Bronowicka-Szydełko	Dr. of Med. Sci.,	Medical sciences	Academic teacher, laboratory diagnostician, biochemist	SE, LC
Ireneusz Ceremuga	Dr. of Med. Sci.,	Medical sciences	Academic teacher, laboratory diagnostician, biochemist	SE, LC
Anna Kałuża	Dr. of Med. Sci.,	Medical sciences	Academic teacher, biologist, chemist	SE, LC
Agata Kozioł	**Dr. eng. Chem. Sci.**	Medical sciences	Academic teacher, chemist	SE, LC

[3] The verification must cover all education results, which are realize in all form of classes within the course

Appendix No.3
to Resolution No. 2303
of Senate of Wroclaw Medical University
of 28 April 2021

Dorota Krzyżanowska-Gołąb	Dr. eng. Chem. Sci.	Medical sciences	Academic teacher, biotechnologist	SE, LC
Anna Lemańska-Perek	Dr. of Med. Sci.,	Medical sciences	Academic teacher, chemist	SE, LC
Łukasz Lewandowski	Dr. Pharm. Sci	Medical sciences, Pharmaceutical sciences	Academic teacher, laboratory diagnostician,	SE, LC
Jolanta Lis-Kuberka	Dr. of Med. Sci.,	Medical sciences	Academic teacher, biotechnologist	SE, LC
Magdalena Mierzchała-Pasierb	Dr. of Med. Sci.,	Medical sciences	Academic teacher, biochemist	SE, LC
Beata Olejnik	Dr. of Med. Sci.,	Medical sciences	Academic teacher, biotechnologist	SE, LC
Małgorzata Pupek	Dr. of Med. Sci.,	Medical sciences	Academic teacher, laboratory diagnostician,	SE, LC
Paweł Serek	Dr. of Med. Sci.,	Medical sciences	Academic teacher, laboratory diagnostician,	SE, LC
Ewa Seweryn	Dr. of Med. Sci.,	Medical sciences	Academic teacher, biochemist	SE, LC
Kamilla Stach	Dr. of Med. Sci.,	Medical sciences	Academic teacher, biochemist	SE, LC
Izabela Szczuka	Dr. of Med. Sci.,	Medical sciences	Academic teacher, biochemist	SE, LC
Justyna Szczykutowicz	MSc. of Med. Sci.,	Medical sciences	Academic teacher, biologist	SE, LC
Łukasz Kotyra	Physician	Medical sciences	Ph.D. student	LC
Aleksander Całkosiński	Physician	Medical sciences	Ph.D. student	LC

Date of Syllabus development

30.06.2021.

Syllabus developed by

Małgorzata Matusiewicz.

Signature of Head(s) of teaching unit(s)

Uniwersytet Medyczny we Wrocławiu
KATEDRA BIOCHEMII I IMMUNOCHEMII
kierownik
prof. dr hab. n. med. Małgorzata Krzystek-Korpacka

Dean's signature

Wroclaw Medical University
Faculty of Medicine
Vice-Dean for Medical Studies
prof. Beata Sobieszczańska, PhD