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: 2020/2021 - 2025/2026

Description of the course

Course	Biochemistry	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	II	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:													
Department of Biochemistry and Immunochemistry (Dep. in charge of the course)													
Direct (contact) education[1]			10			40							
Distance learning[2]	10												
Summer semester:													
Department of Biochemistry and Immunochemistry (Dep. in charge of the course)													

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

Direct (contact) education			10			40							
Distance learning	5												
TOTAL per year:													
Department of Biochemistry and Immunochemistry (Dep. in charge of the course)													
Direct (contact) education			20			80							
Distance learning	15												

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, problem solving.	LE, AC, 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, AC, LC
B.W.3	Knows and understands the terms: solubility, osmotic pressure, isotonia, colloidal solutions and Gibbs-Donnan effect		LE, AC, LC
B.W.4	Knows and understands the basic reactions of inorganic and organic compounds in aqueous solutions		LE, AC, 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, AC, LC
B.W.11	Knows and understands the structure of lipids and polysaccharides and their functions in cellular and extracellular structures		LE, AC, 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, AC, 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, AC, LC
B.W.14	**Knows and understands** the functions of the human genome,		LE, AC, LC

	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	Written tests in a form of short essays, reports, short structured questions	
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		LE, AC, LC
B.W.16	Knows and understands the metabolic profiles of key organs and systems		LE, AC, 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, AC, 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, AC, 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, AC, LC
B.W.23	Knows and understands . the body's ageing mechanism		LE, AC, LC
B.W.25	Knows and understands the relationship between factors disturbing the equilibrium state of biological processes and physiological and pathophysiological changes		LE, AC, 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, AC, 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:	15
3. Number of hours of student's own work:	116
4. Number of hours of directed self-study	n/d
Total student's workload	231

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ECTS points for course	10,0

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

15 lectures (45 min each)

1. Structure and functions of fibrous and globular proteins. Enzymes and their classification.
2. Kinetics and mechanisms of action of enzymes.
3. Mechanisms of regulation of enzymes activity.
4. Isoenzymes. Diagnostic significance of enzymes
5. Tricarboxylic acid cycle. Respiratory chain and oxidative phosphorylation.
6. Oxidative stress and antioxidant potential of the organism. The role of cytochrome P_{450}
7. Functions, transport of lipids and its disturbances.
8. Oxidation and biosynthesis of fatty acids. Triacylglycerols metabolism.
9. Cholesterol metabolism and its disorders. Cholesterol derivatives.
10. The structure and function of eicosanoids. Steroid hormones and the mechanism of their action.
11. Carbohydrates metabolism (digestion and absorption, glycolysis, gluconeogenesis, pentose phosphate pathway).
12. Glycogen metabolism. Fructose and galactose metabolism. Metabolism of heteroglycans. Regulation of carbohydrate metabolism.
13. Nitrogen metabolism – amino acid metabolism. Genetic disorders. Urea cycle. Metabolism of nucleotides, porphyrins and bile pigments.
14. Liver – its role in metabolism (biotransformation reactions). Biochemistry of blood cells.
15. Metabolism of selected macroelements and microelements - its regulation and disorders. Biochemistry of vision (vitamin A significance).

Auditorium classes (45 min each)

1. Introduction to biochemistry. Organization of classes
2. Correlation between structure and function of selected proteins
3. Enzymatic kinetics. Types of inhibition and their biomedical significance. Allosteric enzymes.
4. Regulation of metabolism via enzymatic control (feedback inhibition and covalent regulation, isoenzymes, proenzymes)
5. Biological membrane functions, transport across the membranes on the chosen examples including glycerol-3-phosphate and malate-aspartate shuttle.
6. Oxidoreductases and their cofactors, Krebs cycle – its biomedical significance.
7. Complexes of respiratory chain and disturbances in its function. Reactive oxygen and nitrogen species and antioxidant mechanisms.
8. Digestion and absorption of lipids. Plasma lipoproteins and their biomedical significance.
9. Ketone bodies and their biomedical significance. Hormonal regulation of fatty acids and triacylglycerol metabolism. Metabolism of adipose tissue.
10. Biochemistry of steroids compounds (cholesterol, steroid compounds, vitamin D)
11. Metabolism of glucose and its transport - GLUT-transporters. Regulation of glycolysis and fates of pyruvate in connections to the type and conditions of the cells.
12. Sources of substrates for gluconeogenesis; comparison of the process with glycolysis. Cori and alanine cycle.
13. Allosteric and hormonal regulation of glycogen metabolism. Metabolism of selected isomers of glucose.
14. The course and biomedical significance of hexose monophosphate shunt Hormonal regulation of carbohydrate metabolism. Health implications.
15. Decarboxylation and biologically active amines. Metabolism of phenylalanine and tyrosine – diversity of metabolic pathways and biologically active products.
16. Metabolism of arginine and biomedical role of resulting products. Degradation of heme and biomedical significance of the process.
17. Functions of nucleotides. Origins of uric acid and its biomedical significance.
18. Metabolism of calcium and phosphate. Metabolism of iron. Endogenous regulators of metabolic processes.
19. Biochemistry of muscle contraction. Synthesis of collagen and its disturbances.
20 Specificity of biochemical processes in the liver. The role of the liver in xenobiotics metabolism.

Laboratory classes (180 minutes each)

SECTION I - ENZYMES

1. Introductory classes to winter semester. Determination of pyruvate.

2. Determination of aminotransferases reaction - examination of transamination reaction.
3. Studies on kinetics of phosphatase reaction.
4. Examination of the reaction catalyzed by horseradish peroxidase. Test.

SECTION II – OXIDATIVE PROCESSES
5. Examination of enzymatic reaction catalyzed by succinate dehydrogenase.
6. Examination of the reaction catalyzed by catalase.
7. Anti-oxidative potential - quantitative determination of vitamin C. Test.

SECTION III – LIPID METABOLISM
8. Hydrolysis of lipids. Determination of lipase activity.
9. Total cholesterol, LDL and HDL cholesterol determination in serum. Test.
10. Quantitative determination of triacylglycerols. Repetition of laboratories.

SECTION IV – CARBOHYDRATE METABOLISM
11. Introductory classes to summer semester. Determination of salivary amylase activity.
12. Quantitative determination of sugars. Glycation in microwaves.
13. Effect of pH and temperature on saccharase activity.
14. Glycogen degradation by muscle pulp's enzymes. Test.

SECTION IV – NITROGEN METABOLISM
15. Quantitative determination of urea in urine.
16. Quantitative determination of uric acid.
17. Detection of xanthine oxidase in milk. Quantitative determination of creatinine. Test.

SECTION IV – TISSUE BIOCHEMISTRY
18. Quantitative determination of calcium.
19. Determination of hemoglobin and its derivatives. Test.
20. Quantitative determination of total bilirubin. Repetition of laboratories

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
2. Active participation in seminar classes – analysis and solving scientific problems and involvement in preparation of presentations and active participation in discussion.
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

Final exam:

The exam is conducted in a written form (MCQ, MRQ tests, a choice of yes/no answers, matching answers, open questions) or oral form (standardized sets of questions). The detailed criteria of the grading system are presented in the table below.

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
	Criteria for courses ending with a credit[3]
Credit	

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

Department in charge of the course:	Department of Biochemistry and Immunochemistry
Department address:	Department of Medical Biochemistry Chałubińskiego 10, 50-368 Wrocław
Telephone:	**71 784 13 70** (Department of Medical Biochemistry)
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	AC, LC
Małgorzata Matusiewicz	Dr hab. of Med. Sci.,	Medical sciences	Academic teacher, biochemist	L, AC, LC
Iwona Bednarz-Misa	Dr. of Med. Sci., specialist in medical laboratory diagnostics	Medical sciences	Academic teacher, laboratory diagnostician, biochemist	AC, LC
Izabela Berdowska	Dr. of Med. Sci.,	Medical sciences	Academic teacher, biochemist	L, AC, LC

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

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Mariusz Bromke	Dr. of Natural Sci.	Medical sciences	Academic teacher, biochemist	AC, LC
Agnieszka Bronowicka-Szydełko	Dr. of Med. Sci.,	Medical sciences	Academic teacher, laboratory diagnostician, biochemist	AC, LC
Ireneusz Ceremuga	Dr. of Med. Sci.,	Medical sciences	Academic teacher, laboratory diagnostician, biochemist	AC, LC
Łukasz Lewandowski	Dr. Pharm. Sci	Medical sciences, Pharmaceutical sciences	Academic teacher, laboratory diagnostician,	AC, LC
Magdalena Mierzchała-Pasierb	Dr. of Med. Sci.,	Medical sciences	Academic teacher, biochemist	AC, LC
Paweł Serek	Dr. of Med. Sci.,	Medical sciences	Academic teacher, laboratory diagnostician,	AC, LC
Ewa Seweryn	Dr. of Med. Sci.,	Medical sciences	Academic teacher, biochemist	AC, LC
Kamilla Stach	Dr. of Med. Sci.,	Medical sciences	Academic teacher, biochemist	AC, LC
Izabela Szczuka	Dr. of Med. Sci.,	Medical sciences	Academic teacher, biochemist	AC, 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 Matuszewicz

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 Student Affairs
prof. Beata Sobieszczańska, PhD