SYLLABUS

REGARDING THE QUALIFICATION CYCLE FROM 2024 TO 2030
ACADEMIC YEAR 2024/2025

1. BASIC COURSE/MODULE INFORMATION

Course/Module title	**General and medical chemistry**
Course/Module code *	**ChM /B**
Faculty (name of the unit offering the field of study)	**College of Medical Sciences, University of Rzeszów**
Name of the unit running the course	**Department of Medical Chemistry and Metabolomics**
Field of study	**Medical Direction**
Qualification level	**Uniform master studies**
Profile	**General academic**
Study mode	**Full-time**
Year and semester of studies	**1st year, semester 2,**
Course type	**Mandatory**
Language of instruction	**Polish**
Coordinator	**Dr hab. n. med. Rafał Podgórski, prof. UR**
Course instructor	**Dr hab. Rafał Podgórski** **Dr Sabina Galiniak** **Dr Kornelia Łach**

* - as agreed at the faculty

1.1.Learning format – number of hours and ECTS credits

Semester (no.)	Lectures	Classes	Laboratories	Seminars	Practical classes	Internships	others	**ECTS credits**
2	15		30	15				4

1.2. Course delivery methods
- conducted in a traditional way
- involving distance education methods and techniques

1.3. Course/Module assessment (exam, pass with a grade, pass without a grade)

2. PREREQUISITES

Knowledge of chemistry and biology at an advanced secondary school level.

3. OBJECTIVES, LEARNING OUTCOMES, COURSE CONTENT, AND INSTRUCTIONAL METHODS

3.1. Course/Module objectives

O1	Understanding chemical equilibria, chemical kinetics, and thermodynamics in aqueous solutions
O2	Knowledge of the chemical formulas of physiologically important amino acids, carbohydrates and lipids and the ability to use them, including metabolic records
O3	Ability to use laboratory equipment and perform chemical experiments according to procedures described in the instructions for laboratory exercises
O4	Raising awareness of the need to constantly expand knowledge of the chemical and biochemical basis of processes occurring in the body.
O5	Understanding the mechanisms of homeostasis at the cellular, organ and whole organism level

3.2. COURSE/MODULE LEARNING OUTCOMES (TO BE COMPLETED BY THE COORDINATOR)

Learning Outcome	The description of the learning outcome defined for the course/module	Relation to the degree programme outcomes
LO_01	The student knows and understands the water-electrolyte balance in biological systems;	B.W1
LO_02	The student knows and understands the acid-base balance, the mechanism of buffer action, and their significance in systemic homeostasis;	B.W2
LO_03	The student knows and understands the concepts of solubility, osmotic pressure, isotony, colloidal solutions, and Gibbs-Donnan equilibrium;	B.W3
LO_04	The student knows and understands the structure of lipids and polysaccharides and their functions in cellular and extracellular structures;	B.W9
LO_05	The student knows and understands the primary, secondary, tertiary, and quaternary structures of proteins, as well as post-translational and functional modifications of proteins and their importance;	B.W10
LO_06	The student knows and understands the impact of oxidative stress on cells and its role in the pathogenesis of diseases and in processes associated with aging;	C.W38
LO_07	The student is able to calculate molar and percentage concentrations of compounds, as	B. U3

	well as the concentrations of substances in isoosmotic, single- and multi-component solutions;	
LO_08	The student is able to calculate the solubility of inorganic compounds, determine the chemical basis for the solubility of organic compounds or lack thereof, and understand its practical significance for dietetics and therapy;	B.U4
LO_09	The student is able to determine the pH of a solution and the impact of pH changes on inorganic and organic compounds;	B.U5
LO_10	The student is ready to recognize and identify their own limitations, conduct self-assessment of deficits and educational needs;	K.05
LO_11	The student is ready to use objective sources of information;	K.07
LO_12	The student is ready to draw conclusions from their own measurements or observations, and to use objective sources of information,	K.08

3.3. Course content (to be completed by the coordinator)

A. Lectures

Content outline
Elements, origin, and cycle in nature. Compounds. Water, solubility of compounds in water. Bonds – energy of ionic interactions, covalent, coordination, hydrogen, and van der Waals bonds. Heterogeneous systems with a high degree of dispersion.
Equilibria in aqueous solutions: hydration, dissociation, auto-dissociation of water, strong and weak electrolytes, acids and bases, acid-base equilibrium, pH definition, dissociation constant and degree. Henderson-Hasselbalch equation. Multifunctional compounds – acid-base properties of amino acids. Equilibria in the coordination sphere of metal ions. pH of solutions of acids, bases, salts, and buffer solutions.
Formal oxidation state, redox reactions: ion concentrations in the body, transmembrane potential. Oxidation and reduction reactions in the body, redox potentials, the role of coenzymes and enzymes. Chemical reaction kinetics, reaction order, kinetic equations. Catalysis, the role of catalysts. The role of kinases and phosphatases.
The structure and functions of biological membranes, transport mechanisms, and receptor structure and signal transmission in the cell – types of membrane receptors, chemical messengers and their action, intercellular connections. Amino acids – definition, structure, classifications, amino acid derivatives of biological importance.

Proteins – characteristics of the peptide bond, classification, functions, hierarchical structure of proteins, the relationship between structure and biological function, factors stabilizing protein structure, methods of protein purification and analysis. Protein biosynthesis and post-translational modifications. Biological functions of selected proteins of key physiological significance.
Enzymes as biocatalysts of chemical reactions. Structure and nomenclature of enzymes, coenzymes and their functions, coenzymes and vitamins, biochemical classification of enzymes, factors affecting enzymatic activity, kinetics of enzymatic reactions.
Mechanism of drug action at the molecular and biochemical level. Drug design process.

B. Laboratories

Content outline
Organizational classes: rules for working in a chemistry laboratory, regulations for conducting exercises in the subject "Biochemistry with Elements of Chemistry"
Sparingly soluble compounds and complex compounds.
Solutions.
Buffer solutions and acid-base indicators.
Oxidation-reduction reactions.
Titration.
Application of electrochemical methods in food analysis.
Lipid analysis (1).
Lipid analysis (2).
Characteristic reactions of sugars.

C. Seminars

Content outline
Calculation of molecular masses of compounds based on molecular formulas. Content of sodium and potassium ions in body fluids. Units expressing concentration in medicine
Exercises in calculating the molar concentration (and derivatives) of a compound in an aqueous solution, dilution, and exercises in calculating the mass of a compound (or/and ion) contained in a solution of known concentration.
Exercises in determining the formal oxidation state of carbon in compounds consisting of C, H, O (ethane; ethanol; acetaldehyde; acetic acid; carbon dioxide). Exercises in determining the type of bond between atoms of elements with different electronegativity. Solubility product - saturated and unsaturated solutions. Electrochemical potential.
Calculation of the composition of a buffer solution with a given pH value. Buffers in the human body: carbonate buffer, buffering capacity of proteins.
Partial colloquium 1.
Organic compounds: saturated, unsaturated and aromatic hydrocarbons. Alcohols, aldehydes, carboxylic acids. Amines and amides. Amino acids - equilibria in amino acid solutions

Types and physiological significance of unsaturated fatty acids, digestion and absorption of exogenous lipids, lipid transport. Lipids of physiological significance.
Hormones – chemical structure of hormones, physiological division and classification of hormones based on the mechanism of their action ; molecular mechanism of hormone action .
Biochemistry of oxidative stress. Aging of the organism.
Partial colloquium 2

3.4. Methods of Instruction

e.g.

Lecture:a lecture supported by a multimedia presentation/ distance learning

Seminars: Discussion; Individual work; Group work; Individual answers to questions asked (the answer may be oral or written if it requires drawing a diagram or pattern), presentation of a presentation prepared by the student.

Laboratory classes: designing and conducting experiments

4. Assessment techniques and criteria

4.1 Methods of evaluating learning outcomes

Learning outcome	Methods of assessment of learning outcomes (e.g. test, oral exam, written exam, project, report, observation during classes)	Learning format (lectures, classes,...)
LO_01- LO_06	Written colloquium,	L., SEM .
LO_07- LO_09	Preliminary and final colloquium, report and observation during classes	Lab., SEM.
LO_10- LO_12	Observation during classes	SEM ., LAB

4.2 Course assessment criteria

Attendance at all forms of classes is obligatory.

Semester 2

Lecture : Credit based on attendance and passing seminars, during which the knowledge provided during lectures is also verified.

Seminar : Passing based on written partial tests (2). The subject is passed when all two tests are are passed. Students are entitled to one retake for each test. In the event of failing one test twice, the student may take the semester test covering the entire scope of material covered in that semester. There are no retakes for the semester test. . If a student fails more than one partial test, they fail the semester. To verify the student's preparation for a given seminar, the academic teacher may conduct a preliminary test on the current topics. Failing the preliminary test results in the requirement to retake the class and pass the quiz with a different group. The final grade for the seminars will be calculated based on the average of all tests.

Laboratory: The exercises are conducted in groups of two to three students, with all students participating in the same sessions.

Each student must complete all the exercises. A short preliminary test may be required before starting the exercise, to assess the theoretical knowledge related to the experiment.

Completing the exercise is confirmed by passing the results table and a report approved by the instructor.

The exercises end with a final test covering all the content covered during the exercises (1 hour).

To pass the laboratory exercises, students must pass all preliminary tests, complete all experiments included in the program, provide results and conclusions in a positively evaluated report, and pass the final colloquium. The final grade (FG) for the exercises is the average of the partial grades from the preliminary test (pt), final test (ft), and performance and report (rp) according to the following formula:

FG = 0.2 x pt + 0.1 x rp + 0.7 x ft

Knowledge assessment:

5.0 – Demonstrates knowledge of the curriculum content at a level of 93%-100%

4.5 – Demonstrates knowledge of the curriculum content at a level of 85%-92%

4.0 – Demonstrates knowledge of the curriculum content at a level of 77%-84%

3.5 – Demonstrates knowledge of the curriculum content at a level of 69%-76%

3.0 – Demonstrates knowledge of the curriculum content at a level of 60%-68%

2.0 – Demonstrates knowledge of the curriculum content below 60%

Skills Assessment:

3.0 – Basic mastery of program content, chaotic answers, requires guiding questions, laboratory activities performed with teacher assistance.

3.5 – Basic mastery of program content, structured answers, requires teacher assistance. Laboratory activities are performed with teacher assistance, but with insufficient efficiency.

4.0 – Basic mastery of program content, structured and independent answers. Problem-solving in typical situations, laboratory activities performed independently, fairly efficiently, with minor errors.

4.5 – The presented knowledge goes beyond the basic level, based on supplementary literature. Problem-solving in new and complex situations. Laboratory activities are performed independently, fairly efficiently, and correctly.

5.0 – The presented knowledge goes beyond the basic level, based on independently sourced scientific information. Laboratory activities are performed independently, efficiently, and correctly.

Assessment of social competences:

- continuous assessment by the teacher (observation)

- discussion during classes

- opinions of patients and colleagues

5. Total student workload needed to achieve the intended learning outcomes – number of hours and ECTS credits

Activity	Number of hours
Course hours	**60**
Other contact hours involving the teacher (consultation hours, examinations)	**2**
Non-contact hours - student's own work (preparation for classes or examinations, projects, etc.)	**38**
Total number of hours	**100**
Total number of ECTS credits	**4**

* One ECTS point corresponds to 25-30 hours of total student workload

6. Internships related to the course/module

Number of hours	
Internship regulations and procedures	

7. Instructional materials

Basic Literature:

1. "Harpers Illustrated Biochemistry" 32th Edition- International Edition by Victor Rodwell, Kathleen Botham, Peter Kennelly, P. Anthony Weil, McGraw Hill / Medical, 2022
2. "An Introduction to Medicinal Chemistry" by Patrick Graham, Oxford University Press, 2023

3. "Laboratory of biochemistry and general chemistry for medical students". Galiniak Sabina, Aebisher David, Podgórski Rafał, Kubrak Tomasz Piotr, Bartusik-Aebisher Dorota; Rzeszów : Uniwersytet Rzeszowski, 2021
Complementary literature: 1. "Lippincott Illustrated Reviews: Biochemistry" by David S. Franklin, Emine E. Abali, Susan D. Cline, Susan M. Viselli, Wolters Kluwer Health, 2021

Approved by the Head of the Department or an authorised person