SYLLABUS
REGARDING THE QUALIFICATION CYCLE FROM 2025 TO 3031
ACADEMIC YEAR 2025/2026

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)	**Faculty of Medicine, University of Rzeszów**
Name of the unit running the course	**Department of Medical Chemistry and Metabolomics**
Field of study	**Medicine, Programme in English**
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	**English**
Coordinator	**Assoc. Prof. Rafał Podgórski, PhD, Medical Sciences, University of Rzeszów**
Course instructor	**Assoc. Prof. Rafał Podgórski, PhD, Medical Sciences, University of Rzeszów** **Assoc. Prof. Sabina Galiniak, University of Rzeszów** **Kornelia Łach, PhD, Eng.** **Michalina Grzesik-Pietrasiewicz, PhD, Eng.**

** - 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	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-based 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, isotonic, 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 their 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 well as the concentrations of substances in isosmotic, single- and multi-component solutions;	B. U3
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	B. U4

	thereof, and understand its practical significance for dietetics and therapy;	
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 – properties, biological significance, 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, water autoionization, strong and weak electrolytes, acids and bases, acid-base equilibrium, definition of pH, dissociation constant and degree of dissociation. Henderson–Hasselbalch equation. Equilibria in the coordination sphere of metal ions. Diffusion and osmosis, osmotic and oncotic pressure. Donnan equilibrium.
Formal oxidation state. Redox reactions. Oxidation and reduction reactions in the body, redox potentials, the role of coenzymes and enzymes. Ion concentrations in the body, transmembrane potential. Chemical reaction kinetics – reaction order, rate equations. Catalysis, the role of catalysts. The role of kinases and phosphatases.
Types and physiological significance of unsaturated fatty acids. Digestion and absorption of exogenous lipids, lipid transport. Lipids of physiological importance. Bile acid salts as biological detergents in the gastrointestinal tract.
Hormones – chemical structure of hormones, physiological classification, and classification based on their mechanism of action.
Classification and functions of carbohydrates. Classification, identification, nomenclature, and basic structures of sugars and their derivatives.
Biochemistry of oxidative stress. Aging of the organism.
Mechanism of drug action at the molecular and biochemical levels. Drug design.

B. Laboratories

Content outline
Organizational classes: rules for working in a chemistry laboratory, regulations for conducting exercises in the subject "General and medical 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
Fundamentals of stoichiometry. Standard and non-standard concentration units. Units used to express concentration in medicine.
Stoichiometry of chemical formulas and chemical equations.
Stoichiometry of mixtures.
Solutions (solution concentrations, dilution, and mixing).
Oxidation-reduction reactions, reaction direction, and redox equilibrium.
Calculating the pH of a solution and mixtures of acids and bases. Calculating the pH of buffer solutions. Buffers in the human body.
Solubility product – saturated and unsaturated solutions.

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)
Laboratory classes: designing and conducting experiments

4. ASSESSMENT OF 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	Lectures, seminars
LO_07- LO_09	Preliminary and final colloquium, report and observation during classes	Seminars, laboratories
LO_10- LO_12	Observation during classes	Seminars, laboratories

4.2. Course assessment criteria

Attendance at all forms of classes is obligatory.

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

Seminar: Passing based on written colloquium. The seminar is passed upon successful completion of the final test. Students are entitled to one retake of each test. In the case of two failed attempts, the student may take a comprehensive semester test covering the entire material from the semester. There is no possibility to retake the semester test. To assess a student's preparedness for a given seminar, the academic instructor may administer a preliminary test on current topics. Failure to pass the preliminary test results in the requirement to repeat the class and take the test with another group. The final grade for the seminars is the grade obtained from the final test.

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. **The laboratories end with a final test covering all the content covered during the practical classes (1 hour).**

The completion of the practical class is confirmed by passing all preliminary tests, completing all experiments included in the program, submitting a report approved by the instructor, and passing the final laboratory test. The final grade (FG) for the laboratories 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

Students who achieve an average score of 4.9 or higher from preliminary tests and reports are exempt from the final laboratory test.

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, 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, 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 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 academic staff (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**

** Please note that 1 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. Lippincott® Illustrated Reviews: Biochemistry by Susan M. Viselli, Emine E. Abali, Susan D. Cline, Wolters Kluwer Health, 2025.
2. An Introduction to Medicinal Chemistry by Patrick Graham, Oxford University Press, 2023.
3. Laboratory of biochemistry and general chemistry for medical students by Sabina Galiniak, David Aebisher, Rafał Podgórski, Tomasz Kubrak, Dorota Bartusik-Aebisher, Rzeszów University Press, 2021.

Complementary literature:

1. Harpers Illustrated Biochemistry 32nd Edition- International Edition by Victor Rodwell, Kathleen Botham, Peter Kennelly, P. Anthony Weil, McGraw-Hill Education, 2022.

Approved by the Head of the Department or an authorized person