Annex No. 1.5 to the Rector's Order of the UR No 7/2023

SYLABUS

Concerning the cycle of education ***2024-2030***

Academic year 2025/2026

1. BASIC INFORMATION CONCERNING THIS SUBJECT

Subject name	**Biochemistry**
Subject code*	**BCh/B**
Name of the unit conducting the course	**Faculty of Medicine, University of Rzeszow**
Name of the unit conducting the course	**Department of Photomedicine and Physical Chemistry**
Field of study	**Medicine**
Level of study	**Uniform master studies**
Profile	**General academic**
Form of study	**Stationary/ non- stationary**
Year and semester/s of studies	**Year I, semester II, Year II, semester III**
Type of subject	**Obligatory**
Language of instruction	**English**
Coordinator	**Assoc. Prof. David Aebisher, University of Rzeszów**
Name and surname of the person conducting the course	**Assoc. Prof. David Aebisher, University of Rzeszów**

* -optional, as agreed in the Unit

1.1. Forms of teaching, number of hours and ECTS points

Semester No.	Lecture	Exercise	Conversation	Laboratory	Seminar	Practical	Other	**Number of points ECTS**
2	20	-	-	-	15	-	-	8
3	20	30	-	-	15	-	-	8

1.2. The method of conducting classes

☒ Classes are conducted in a traditional format

☐ **C**lasses conducted using distance learning methods and techniques

1.3. Form of course credit (in progress) (**exam**, pass with grade, pass without grade)

2. PREREQUISITES

Completed I semester of the course in biochemistry with elements of chemistry.

3. OBJECTIVES, LEARNING OUTCOMES, PROGRAM CONTENT AND TEACHING METHODS USED

3.1. Subject Objectives

C1	Understanding chemical equilibria, kinetics and chemical thermodynamics in aqueous solutions
C2	Knowledge of the chemical formulas of amino acids, carbohydrates and lipids of physiological significance and the ability to use them, including records of metabolic changes
C3	Ability to use laboratory equipment, perform chemical and biochemical experiments according to the procedures described in the instructions for laboratory exercises
C4	Ability to use metabolic transformation patterns (pathways) in the field of protein synthesis and degradation, carbohydrate, fat and fatty acid metabolic pathways, along with regulation and its disorders
C5	Knowledge and understanding of the flow of genetic information, knowledge of genetic diseases
C6	Understanding the mechanisms of homeostasis at the cell, organ and body level
C7	Ability to conduct biomolecule analysis by electrophoretic methods and selected outpatient blood and urine analyzes

3.2. Learning outcomes for the subject

EK (learning outcome)	Content of the learning outcome defined for the subject	Reference to directional effects [1]
EK_01	The student knows and understands the structure of lipids and polysaccharides and their functions in cellular and extracellular structures;	B. W9
EK_02	The student knows and understands the structure of simple organic compounds that are part of macromolecules present in cells, extracellular matrix and body fluids;	B. W10
EK_03	The student knows and understands the structure of lipids and polysaccharides and their functions in cellular and extracellular structures;	B. W11

[1] In the case of a training path leading to a teaching qualification, also take into account the learning outcomes from the standards for training to practice as a teacher.

EK_04	The student knows and understands the I-, II-, III- and IV-order structures of proteins as well as post-translational and functional modifications of proteins and their meaning;	B. W12
EK_05	The student knows and understands the functions of nucleotides in the cell, the structure of primary and secondary DNA and RNA, and the structure of chromatin;	B. W13
EK_06	The student knows and understands the basic catabolic and anabolic pathways, ways of their regulation and the influence of genetic and environmental factors on them;	B. W15
EK_07	The student is able to predict the direction of biochemical processes depending on the energy state of cells;	B. U6
EK_08	The student is able to plan and carry out scientific research, interpret their results and draw conclusions;	B. U11
EK_09	The student is able to use basic laboratory and molecular techniques.	B. U12
EK_10	The student is ready to see and recognize their own limitations and to make self-assessments of educational deficits and needs;	K.05
EK_11	The student is ready to use objective sources of information;	K.07
EK_12	The student is able to formulate conclusions based on his/her own measurements or observations;	K.08
EK_13	The student is ready to accept the responsibility associated with decisions taken as part of his professional activity, including in terms of his own safety and the safety of others.	K.11

3.3. Program content

A. Topics of the lecture

Semester 2

Course contents
Amino acids and the peptide bond, primary and higher protein structures
Myoglobin and hemoglobin
Enzymes: mechanism of action
Enzyme kinetics
Enzyme regulation of Activities / Transition metals
Bioenergetics: role of ATP
Bioenergetics: role of ATP

Biological oxidation/Respiratory chain and oxidative phosphorylation
Overview of metabolism/carbohydrates
The citric acid cycle
Glycolysis and Oxidation of pyruvate
Metabolism of glycogen/gluconeogenesis
Pentose phosphate pathway

Semester 3

Course contents
Lipid metabolism part 1 (ketogenesis, biosynthesis, metabolism)
Lipid metabolism part 2 (storage, cholesterol synthesis, transport and excretion)
Metabolism of proteins and amino acids part 1 (biosynthesis, catabolism, conversion, porphyrins and bile pigments)
Nucleotides/metabolism of purine/pyrimidine
Nucleic acids/DNA replication
RNA synthesis and modification
Protein synthesis
Regulation of gene expression
Special topics: membranes
Nutrition/micronutrients
Glycoproteins
Clinical Biochemistry part 1
Clinical Biochemistry part 2

B. Problems of tutorials, seminars, laboratories and practical classes

Laboratories

COURSE CONTENTS - SEMESTER 3

Characteristic reactions of amino acids.
Properties of proteins.
Electrophoresis of blood serum proteins in agarose gel. Thin layer chromatography
Serumglucoseandtotalbilirubinanalysis.Determination of the concentration of hemoglobininthe blood
Analysis of normal and pathological urine.
Determination of α-amylase activity. The influence of factors on enzyme activity.
Detection of enzymatic activity.
Determinationofthe concentrationofreduced glutathione inthe liver. Determinationofthe abilityto scavenge freeradicals.
Characteristic reactions of vitamins.

C. SEMINARS

COURSE CONTENTS - SEMESTER 3
Electrochemical potential. supplementary content of the lecture: passive and active transport through membranes.
PARTIAL TEST 1
Protein metabolism. protein functions. pKa values of amino acids and amino acid functional groups in the protein structure.
Active enzyme centers and regulation of enzymatic activity. inhibitors and enzyme activators
Supplementary content lecture: transformation of amino acids into specialized products
PARTIAL TEST 2
Bioenergetics: glycolysis, Krebs cycle, pentose phosphate pathway
Fat and fatty acid metabolism
Supplementary content lecture: synthesis, transport and excretion of cholesterol
PARTIAL TEST 3

COURSE CONTENTS - SEMESTER 3

Protein synthesis and genetic code.
Supplement: recombinant DNA techniques
Regulation of gene expression.
PARTIAL TEST 1
Membranes: structure and functions.
Hormonal effects and signal transduction
Endocrine system. hormonal effects and signal transduction.
Partial test 2
Nutrition, digestion and absorption.
Roles of glycoproteins, plasma proteins, cell membranes and blood group substances
Extracellular substances. biochemistry of smooth and striated muscle contraction. the role of acting and myosin, the contribution of ca2 + and atp ions in muscle contraction.
Partial test 3

3.4 Teaching methods

Lecture: problem lecture, lecture with multimedia presentation, distance learning methods

Seminar: text analysis with discussion, project method (research, implementation, practical project), group work (task solving, discussion), didactic games, distance learning methods

Exercise: performing experiments, designing experiments.

4. EVALUATION METHODS AND CRITERIA

4.1 Ways to verify learning outcomes

Effect symbol	Methods of assessing learning outcomes (e.g.: colloquium, oral exam, written exam, project, report, observation during classes)	Form of didactic classes (l, ext, ...)
EK_ 01-EK_11	WRITTEN TEST, EXAM	L., SEM.
EK_ 12-EK_20	PRELIMINARY AND FINAL COLLOQUIUM, REPORTS AND OBSERVATIONS DURING CLASSES	EXERCISE,
EK_17-EK20	OBSERVATION DURING CLASSES	SEM.

4.2. Conditions for passing the course (assessment criteria)

Semester 2

Lecture: Credit based on attendance. The course ends with an exam after a one-year

Seminar: Assessment based on written colloquia (3). The subject is passed when all three tests are positive. The student has the right to one correction date for each of the tests. In the event of failing one of the colloquiums twice, the student may proceed to the semester colloquium from the entire scope of material covered in this semester. Correction dates from the semester test are not foreseen. In the event of failing more than one partial test, the student will not pass the semester. In order to verify the student's preparation for a given seminar, the lecturer will conduct introductory colloquia on current topics. Failure to complete the initial test results in the obligation to do the homework and pass the initial test with another group.

Exercises: Classes are performed in two/three-person groups by all students during the same classes.

Each student must complete all the exercises, . The condition for starting the exercise may be a short initial test that checks the theoretical knowledge related to the perform experiment.

The laboratory classes end with a final test covering all the content discussed during the exercises (1 hour)

The condition of obtaining credit for the laboratory exercises is to pass the preliminary tests, to perform all the experiments contained in the program, to describe the results and conclusions in a positively evaluated report and pass the final test.

The final grade from the exercises is the average of partial grades from: preliminary tests **(kw),** final test **(kk),** performance and report **(sp)** of the exercise, calculated according to the formula:

$$\mathbf{OK = 0.2 \times kw + 0.1 \times sp + 0.7 \times kk}$$

Semester 3

Lecture: Credit based on attendance. The course ends with an exam after a one-year course.

Seminar: Assessment based on written colloquia (3). The subject is passed when all three tests are positive. The student has the right to one correction date for each of the tests. In the event of failing one of the colloquiums twice, the student may proceed to the semester colloquium from the entire scope of material covered in this semester. Correction dates from the semester test are not foreseen. If more than one partial test is not passed, the student fails the semester. In order to verify the student's preparation for a given seminar, the lecturer

will conduct introductory colloquia on current topics. Failure to complete the initial test results in the obligation to do the homework and pass the initial test with another group.

Exercises: The condition of obtaining credit for laboratory exercises is to perform all the experiments contained in the program, to describe the results and conclusions in a positively evaluated report. Exercise may be preceded by an initial test checking preparation for classes.

Classes end with a final test covering all the content discussed during the classes (1 hour).

THE FINAL GRADE FROM THE EXERCISES IS THE AVERAGE OF PARTIAL GRADES FROM: FINAL TEST, PERFORMANCE AND REPORT OF THE EXERCISE.

EXAM:

The condition of admission to the exam is a positive grade from the seminar (from both semesters) and laboratory exercises (from both semesters) and credit from lectures.

The exam is in writing
Single choice test (80-100 questions, scored 1 point for correct answer). Test duration - 90 minutes.
Students are entitled to two exam dates: date I and retake date.
FINAL ASSESSMENT (OK) of the subject is a weighted average of the average of six grades of colloquium **(S)** seminar, exam **(E)** and final grade from laboratory **(C)** in the proportion:

$$OK = 0.4 \times S + 0.4 \times E + 0.2 \times C$$

Knowledge assessment:

5.0 - shows knowledge of education content at the level of 93% -100%
4.5 - shows knowledge of education content at the level of 85% -92%
4.0 - shows knowledge of education content at the level of 77% -84%
3.5 - shows knowledge of education content at the level of 69% -76%
3.0 - shows knowledge of education content at 60% -68%
2.0 - shows knowledge of education content below 60%

Skill assessment:

3.0- Mastering program content at the basic level, chaotic answers, necessary guidance questions, performing laboratory activities with the help of a teacher.
3.5- Mastering program content at the basic level, systematic answers, requires the help of a teacher. Laboratory activities performed with the help of a teacher, with inadequate performance.
4.0- Mastering program content at the basic level, systematized, independent answers. Solving problems in typical situations, laboratory activities performed independently, quite efficiently, with a small amount of error.

4,5- The scope of presented knowledge exceeds the basic level based on the supplementary literature provided. Solving problems in new and complex situations. Laboratory activities carried out independently, quite efficiently and correctly. 5.0- The scope of presented knowledge goes beyond the basic level based on independently acquired scientific sources of information, laboratory activities carried out independently, efficiently and correctly

5. TOTAL STUDENT WORKLOAD NEEDED TO ACHIEVE THE INTENDED RESULTS IN HOURS AND ECTS POINTS

Activity	The average number of hours to complete the activity
Contact hours (with the teacher) resulting from the study schedule of classes	100
Contact hours (with the teacher) participation in the consultations, exams	10
Non-contact hours - student's own work (preparation for classes, exam, writing a paper, etc.)	90
SUM OF HOURS	200
TOTAL NUMBER OF ECTS	**8**

** Please note that 1 ECTS point corresponds to 25-30 hours of total student workload.*

6. WORKSHOP PRACTICE WITHIN THE SUBJECT

Number of hours	-
Rules and forms of apprenticeship	-

7. LITERATURE

BASIC LITERATURE:

HARPER'S ILLUSTRATED BIOCHEMISTRY THIRTY-FIRST EDITION 31ST EDITION BY VICTOR RODWELL, DAVID BENDER, KATHLEEN BOTHAM, PETER KENNELLY, P. ANTHONY WEIL

" LABORATORY OF BIOCHEMISTRY AND GENERAL CHEMISTRY FOR MEDICAL". GALINIAK SABINA, AEBISHER DAVID, PODGÓRSKI RAFAŁ, KUBRAK TOMASZ PIOTR, BARTUSIK-AEBISHER DOROTA; RZESZÓW : UNIWERSYTET RZESZOWSKI, WYDANIE 1, 2021 (ISBN: 978-83-7996-877-0).

ADDITIONAL LITERATURE: BERG JEREMY M., TYMOCZKO JOHN L., STRYER LUBERT, GATTO GREGORY J.BIOCHEMISTRY, PWN, WARSZAWA 2018, WYD.5

Approved by the Head of the Department or an authorised person