COURSE DESCRIPTION

Modern methods for Characterization of Biomolecules

Academic year 2026-2027

1. Programme-related data

1.1. Higher Education Institution	Babeș-Bolyai University
1.2. Faculty	Chemistry and Chemical Engineering
1.3. Department	Chemistry
1.4. Field	Chemistry
1.5. Level of study	Master
1.6. Degree programme / Qualification	Chemical biology in life and medical sciences
1.7. Form of education	Full-time education

2. Course-related data

2.1. Course title	Modern methods for Characterization of Biomolecules			Course code	CME6107
2.2. Course coordinator	Dr. Habil. Constantin Adrian APETRI				
2.3. Seminar coordinator	Dr. Habil. Constantin Adrian APETRI				
2.4. Year of study	1	2.5. Semester	2	2.6. Type of assessment	Exam
2.7. Course status	Compulsory			2.8. Course type	Specialisation subject

3. Total estimated time (hours per semester of teaching activities)

3.1. Number of hours per week	4	of which: 3.2. course	2	3.3. seminar	2
3.4. Total of hours in the curriculum	56	of which: 3.5. course	28	3.6. seminar	28
Time allocation for individual study (IS) and self-taught activities (ST)					**hours**
Learning from textbooks, course materials, bibliography, and notes (IS)					30
Additional research in the library, on subject-specific electronic platforms, and on-site					10
Preparing seminars/ laboratories/ projects, assignments, reports, portfolios, and essays					19
Tutoring (professional guidance)					4
Examinations					6
Other activities					
3.7. Total hours of individual study (IS) and self-taught activities (ST)				**69**	
3.8. Total hours per semester				**125**	
3.9. Number of credits				**5**	

4. Prerequisites (where applicable)

4.1. curriculum-related	Basic knowledge from undergraduate level courses
4.2 skills-related	Minimum kinesthetic-motor skills

5. Specific conditions (where applicable)

5.1. course-related	Being late to class will not be accepted Students will not use mobile phones during class
5.2. seminar/laboratory-related	•Students' responsibilities for the course and laboratory: a) Conduct periodic research using available sources, including specialized libraries, international electronic databases, and materials provided by the course instructor. b) Understand the objectives, methods, equipment, instruments, and steps involved in the laboratory experiments they will perform. c) Adhere to occupational safety regulations and behavioral guidelines established by the institution/faculty.

	d) Complete assignments, case studies, and reports and present them as required. •Students will have access to written course and laboratory materials, as well as other scientific resources (articles, studies, books). •Attendance of at least 80% of laboratory activities is a prerequisite for taking the exam.

6.1. Competencies resulting from the completion of the degree programme *(as referred to in the curriculum)*[1]

Professional competencies	
Competency code	**Competency**
PC1	Formulating solutions for solving complex issues of biochemistry and applications of chemistry and it's methods and tools in biological systems based on the knowledge and application of advanced concepts, methods from the field of biochemistry, genetics, molecular biology, and bioinformatics.
PC2	Knowledge and application of advanced bioanalytical techniques for understanding of specific interactions in biological systems.
PC3	Knows and explains at the molecular level the role and metabolism of biomacromolecules, enzymes, their mechanism of action, and how primary/secondary metabolites are generated.
Transversal competencies	
Competency code	**Competency**
TC2	Familiarization with new scientific research strategies: systematic research of specialized literature, design and practice of experiments
TC3	Designing, planning and performing an individual scientific, multidisciplinary research project

6.2. Learning outcomes relevant to the degree programme (as referred to in the curriculum)[2]

Learning outcomes targeted by the subject		
Competency code	**Knowledge and comprehension**	**Specific academic skills**
CP1, CP2, CP6	4. Knowledge of advanced bioanalytical techniques for understanding of specific interactions in biological systems.	4. Creative use of knowledge of the bioanalytical tehniques for the structural and functional analysis of biomacromolecules.
CP5, CP6	6. The student/graduate knows the basic principles of a recombinant DNA technology, genetic engineering and the stages of technology development for the production of proteins	6. The student/graduate proposes technologies for obtaining useful protein products, including their separation/purification steps

7. Subject-specific learning outcomes

Knowledge and comprehension
1. Use of in-depth knowledge, theories and models of biochemistry to use the analysis methods specific to the main classes of biomacromolecules
2. Knowledge of advanced bioanalytical and computational methods used in metabolite identification, including LC-MS techniques, in vitro/in vivo model systems, and protein-ligand interaction analysis via structural databases (PDB, EXPASY) and visualization tools (PyMOL).
3. Definition of the basic notions, concepts, theories and models of structural biochemistry and metabolism
Specific academic skills

[1] The professional and/or transversal skills targeted by the subject for which the course description is prepared will be copied from the curriculum of the degree programme. For each competency, the complete entry, including the competency code, will be copied with the exact wording that appears in the curriculum, without any changes. If no competency is copied from either of the two categories, the row corresponding to that category is deleted from the table.

[2] The learning outcomes relevant for the degree programme and targeted by the subject for which the course description is prepared will be listed. The entries, copied without any changes from the Curriculum by subject type (Core Subject/Specialisation Subject/Complementary Subject), are listed under the corresponding competency.

1. Identification and application of concepts, methods and theories for determining the structure of the main classes of biomacromolecules
2. Ability to identify and apply new perspectives in the field of biochemistry and bioanalysis and application of concepts, methods and theories to propose new directions of development.

8. Contents

8.1 Course	Teaching methods	Remarks
8.1.1. Introduction: Nomenclature, classes and structural features of the main classes of biomacromolecules	Lecture; Explanation; Conversation.	
8.1.2. Sources and isolation/purification process of samples containing different biomacromolecules.	Lecture; Explanation; Conversation.	
8.1.3-4. Determination of the primary structure of proteins. Edman sequencing, enzymatic and chemical fragmentation coupled with LC-MS techniques for determining the sequence of peptide fragments.	Lecture; Explanation; Conversation.	
8.1.5. Determination of the tertiary/quaternary structure of proteins. Protein crystallization, X-ray diffraction of proteins, cryo-electron microscopy.	Lecture; Explanation; Conversation.	
8.1.6. Structural determination of protein complexes. Immunoprecipitation, Native-PAGE, photoaffinity labeling, steric exclusion chromatography.	Lecture; Explanation Conversation; Description	
8.1.7-8. Determination of the primary structure, DNA sequence. Sanger sequencing method. Next Generation Sequencing (NGS) methods.	Lecture; Explanation Conversation; Description.	
8.1.9. Chromatographic methods - generalities and specific applications in the analysis of biomacromolecules	Lecture; Explanation Conversation; Description; Problematization.	
8.1.10. Mass spectrometry, ESI and MALDI techniques, applications in the detection of macromolecules	Lecture; Explanation Conversation; Description; Problematization.	
8.1.11. Determination of lipid structure by ESI-MS and MALDI-MS mass spectrometry.	Lecture; Explanation Conversation; Description; Problematization.	
8.1.12. Determination of the structure of carbohydrates, oligosaccharide components from different macromolecules	Lecture; Explanation Conversation; Description.	
8.1.13. Use of nuclear magnetic resonance in the structural characterization of biomacromolecules	Lecture; Explanation; Conversation.	
8.1.14. Coupled techniques in the structural characterization of biomacromolecules	Explanation; Conversation; Description; Problematization; Debate;	
Bibliography 1. The course support 2. Fersht, A., Structure and Mechanism in Protein Science. A Guide to Enzyme Catalysis and Protein Folding. third ed. 1999, New York: WH Freeman and Co. 3. Rehm, H.J., G. Reed, A. Puchler, si P. Statdler, Biotechnology Vol3. Bioprocessing.1993, Weinheim: WCH.		
8.2 Seminar / laboratory	Teaching methods	Remarks
8.2.1. Liquid chromatography 1 – size exclusion chromatography – determination of the quaternary structure of oligomeric proteins	Experiment; Explanation; Conversation; Description; Problematization	Since the time required to conduct a seminar/laboratory session is at least 4 hours, 7 previously scheduled meetings will be held.
8.2.2. Protein crystallization – apparatus/methodology/visualization of the crystal structure	Experiment; Explanation; Conversation; Description; Problematization	

8.2.3. Isolation of lipid components from bacterial membranes and their structural analysis by ESI-MS	Experiment; Explanation; Conversation; Description; Problematization	
8.2.4. Enzymatic fragmentation of the polypeptide sequence	Experiment; Explanation; Conversation; Description; Problematization	
8.2.5. LC-MS analysis of peptide fragments, reassembly of the protein sequence	Explanation; Conversation; Description; Problematization	
8.2.6. Biomacromolecule labeling techniques	Explanation; Conversation; Description; Problematization	
8.2.7. Verification test	Written test	
Bibliography 1. Laboratory papers 2. Reviews and articles from recent literature		

9. Evaluation

Type of activity	9.1 Evaluation criteria[3]	9.2 Evaluation methods[4]	9.3 Percentage in the final grade
9.4. Course	Correctness of answers - correct assimilation and understanding of the issues covered in the course	Two oral examinations during the semester Intention to cheat on the exam is punished by elimination from the exam. Cheating on the exam is punished by expulsion according to the ECTS regulation of UBB.	75%
	Correct problem solving		
9.5 Seminar/Laboratory	Correctness of answers - correct assimilation and understanding of the issues covered in the laboratory class	Laboratory/seminar activity, test	25%
	The activity carried out within the seminar/ laboratory sessions		
9.6 Minimum standard for passing			
✓ Grade 5 (five) both in the seminar/laboratory test and in the exam according to the scale. ✓ Knowledge of introductory concepts; ability to identify nutrients typically present in a given food or diet; ability to analyze the metabolic pathways of the respective nutrients, and the ways to regulate those pathways			

10. SDG labels (Sustainable Development Goals)[5]

	○	Sustainable Development Generic Label
		

[3] The evaluation criteria must directly reflect the learning outcomes targeted at the level of the degree programme respectively at the level of the subject. More specifically, the learning outcomes set out in the expected learning outcomes are assessed.

[4] Both final evaluation methods and ongoing evaluation strategies should be established.

[5] Select a single label which, according to the *Implementation of SDG labels in the academic process*, best matches the subject. If the subject addresses sustainable development in a generic manner (i.e. by presenting/introducing the general framework of sustainable development, etc.), then the Sustainable Development generic label may be applied. If none of the labels describe the subject, select the last option: *"No label applies."*

○	○	✓	✓	○	○	○	○	✓
								No label applies
○	○	✓	○	○	○	○	○	○

Date of entry:
20.04. 2026

Signature of course coordinator
Dr. Habil. Constantin Adrian APETRI

Signature of seminar coordinator
Dr. Habil. Constantin Adrian APETRI

Date of approval in the department:
24.04.2026

Signature of the head of department
Prof. Dr. Ing. Monica Ioana TOȘA