SYLLABUS

Molecular Biochemistry and Biophysics

Academic year 2025-2026

1. Information regarding the programme

1.1. Higher education institution	Babeș-Bolyai University	**Babeș**
1.2. Faculty	Faculty of Biology and Geology	**Facult**
1.3. Department	Department of Molecular Biology and Biotechnology	**Depar**
1.4. Field of study	Biology	**Biolog**
1.5. Cycle of studies	Master, 4 semesters	**Maste**
1.6. Curriculum/Qualification	Bioinformatics Applied in Life Sciences (English)/ Biologist	**Appli**
1.7. Form of education	Full-time	**Full-t**

2. Information regarding the discipline

2.1. Name of the discipline	**Molecular Biochemistry and Biophysics**					Discipline Code	**BME1113**
2.2. Course coordinator	Lecturer. Dr. Rauca Valentin-Florian						
2.3. Seminar coordinator	Lecturer. Dr. Rauca Valentin-Florian						
2.4. Year of study	**I**	2.5. Semester	**1**	2.6. Type Evaluation	**E**	2.7. Discipline regime	**Optional**

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

3.1. Hours per week	**4**	of which: 3.2 course	**4**	3.3 seminar/laboratory	**4**
3.4. Total hours in the curriculum	56	of which: 3.5 course	28	3.6 seminar/laborator	**28**
Time allotment for individual study (ID) and self-study activities (SA)					**hours**
Learning using manual, course support, bibliography, course notes (SA)					30
Additional documentation (in libraries, on electronic platforms, field documentation)					30
Preparation for seminars/labs, homework, papers, portfolios and essays					**26**
Tutorship					**8**
Evaluations					**4**
Other activities: two-way communication with the course holder / tutor					-
3.7. Total individual study hours	**98**				
3.8. Total hours per semester	**154**				
3.9. Number of ECTS credits	**6**				

4. Preconditions (where applicable)

4.1. Curriculum	**•Elementary Algebra**
4.2. Competences	**•Computer skills**

5. Conditions (where applicable)

5.1. Course Conduct	•Projector •Online communication platform
5.2. conducting the seminar/laboratory	• Participation in at least 90% of the seminar/laboratory activities. •Laboratory room with appropriate equipment for biochemistry and biophysics • Computers, specific development and implementation environments

6.1. Specific competences accumulated[1]

Professional/essential skills	• Developing the ability to explain fundamental biological phenomena as a consequence of the functioning of the laws of physics and chemistry under the conditions of structural complexity offered by living systems • Ability to use essential laboratory techniques in the study of life and the conception of experimental design, obtaining measurement data, analyzing / interpreting them and formulating conclusions • Developing the capacity for analysis, synthesis and communication of specialized scientific information.
Transversal competences	• Acquiring the necessary/complementary information for the assimilation of the content of the disciplines of Genomics and Functional Genomics, Structural Bioinformatics and Proteomics • Use of concepts specific to the molecular/cellular level of organization of life in new contexts (in vitro, cellular, tissue)

6.2. Learning outcomes

Knowledge	The student knows the structure and composition of basic biomolecules (proteins, carbohydrates, lipids, nucleic acids), the principles of enzymatic catalysis, the main metabolic pathways and basic concepts of bioenergetics, the basics of thermodynamics and physical interactions in biological systems, the relevant experimental methods (chromatography, microscopy, electrophoresis, PCR)
Skills	The student is able to explain how chemical properties influence biological functions, interpret the relationship between structure and function, interpret the behavior of biomolecules according to physicochemical conditions, choose the appropriate technique for investigating certain properties of biomolecules, use specialized tools for processing and interpreting molecular information,
Responsibilities and autonomy	The student has the ability to work independently to integrate this knowledge into bioinformatics projects and applications

7. Objectives of the discipline (resulting from the grid of accumulated skills)

7.1 General objective of the discipline	• Description of the basic physical and physico-chemical phenomena in living matter and interpretation of some fundamental aspects of life through the prism of the laws of physics; the formation of a rational conception about the functioning of living systems, on natural bases.
7.2 Specific objectives	• Understanding cellular functions as the finality of physicochemical interactions between biomacromolecules, between cell organelles and cells. • Knowledge of the physical and chemical phenomena that influence and determine the structure and functions of the cell. • Understanding the functioning and application of laboratory instruments for the study of biomolecular and cellular structures.

8. Contents

8.1 Course	Teaching methods	Observations
The atom and the molecule. Atomic and molecular orbitals. Primary chemical bonds.	Interactive exhibition Presentation Explaining Practical examples Discussions on case studies	
Secondary chemical bonds. Edification of supramolecular structures.		
Carbohydrates and lipids. Structures and roles.		
Amino acids and proteins. Peptide bonding, protein structure levels. Functions of proteins.		
Enzymes and coenzymes. Enzymatic catalysis.		
Nucleotides and nucleic acids (DNA, RNA). Structure and roles		
Protein, protein-nucleic acid and protein-ligand interactions.		
Principles of biophysical methods and techniques for investigating the cell, nucleic acids and protein structure		
Cell Metabolism: Principles, Types of Biochemical Pathways.		

Bibliography

1. Alberts B., Johnson A., Lewis J., Molecular Cell Biology. New York; Abingdon: Garland Science, Taylor & Francis Group, 2008.
2. Frauenfelder H., Chan S. S., Protein Physics: An Introduction to Biological Physics and Molecular Biophysics. New York: Springer, 2010.
3. Glaser, Roland. Biophysics, 2005.
4. Lesk A. M., Introduction to Protein Architecture: Structural Biology of Proteins. New York; Oxford University Press, 2003.
5. Nelson P. C. et al., Biological Physics: Energy, Information, Life. New York: W. H. Freeman, 2008.
6. Papachristodoulou D., Snape A., Elliott W.H., Elliott D.C., Biochemistry and Molecular Biology. Oxford: Oxford University Press, 2014.
7. Phillips R., Kondev J., Theriot J., Garcia H.G., Orme N., Physical Biology of the Cell. London; New York: Garland Science, 2013.

All titles are available in printed form at the libraries of the Faculty of Biology and Geology.

8.2 Seminar / laborator	Teaching methods	Observations
Seminar: Methods of investigation of biological compounds: separation (centrifugation, electrophoresis, chromatography)	Interactive exhibition Explaining Conversation Practical demonstration	
Seminar: Methods for investigating biological compounds: qualitative methods (electron microscopy, X-ray diffraction, FTIR, Raman spectrometry)		
Seminar: Methods for investigating biological compounds: quantitative methods (spectrometry – spectrophotometry, spectrofluorimetry, mass spectrometry)		
Practical work: centrifugal separation of biological samples and electrophoresis of nucleic acids and proteins		
Practical work: spectrophotometric and spectrofluorimetric dosing of nucleic acids and proteins		
Practical work: electron microscopy (demonstrative)		
Practical work: mass spectrometry (demonstrative)		
Final evaluation		

Bibliography

1. Copeland R. A., Enzymes: A Practical Introduction to Data Structure, Mechanism, and Analysis. New York: VCH, 1996.
2. Davidovits, P. Physics in Biology and Medicine, 2008.
3. Glusker JP, Lewis M., Crystal Structure Analysis for Chemists and Biologists. New York; Weinheim; Cambridge: VCH Publishers, 1994.
4. Mason W.T., Fluorescent and Luminescent Probes for Biological Activity: A Practical Guide to Technology for Real-Time Quantitative Analysis. London, Academic Press, 1993.
5. Wilson K., Principles and Techniques of Biochemistry and Molecular Biology. Cambridge: Cambridge University Press, 2010.

All titles are available in printed form at the libraries of the Faculty of Biology and Geology

9. To corroborate the contents of the discipline with the expectations of the representatives of the epistemic community, professional associations and employers representative of the field related to the program

- The course is applicative and allows the acquisition of practical skills necessary for working in laboratories of analysis and interpretation of biological and theoretical data necessary for advanced bioinformatics analysis in research institutes or in R&D units at pharma and biotech companies.
- The course is present in the curricula of similar specializations at universities in the country and abroad.

10. Evaluation

Activity Type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Weight of the final grade
10.4 Course	Knowledge of the concepts and methods of the course theme	Written exam	50%
10.5 Seminar/laborator	Application of qualitative and quantitative analysis techniques in real problems	Oral exam (colloquium)	50%
10.6 Minimum Performance Standard			
• Each student must obtain at least 5 (five) in the written exam and the oral colloquium. In order to obtain a minimum grade of 5 (five), the student must demonstrate the acquisition of the basic concepts of the course topic.			

11. SDG (Sustainable Development Goals) labels[2]

	3. Health and Well-being

Date of completion:
08.01.2025

Signature of the course holder

Lecturer. Dr. Rauca Valentin-Florian

Signature of the seminar holder

Lecturer. Dr. Rauca Valentin-Florian

Date of approval in the department:
8.01.2025

Signature of the department director

Assoc. Prof. Beatrice Kelemen, PhD