COURSE DESCRIPTION

INTEGRATIVE BIOINFORMATICS

Academic year 2026-2027

1. Programme-related data

1.1. Higher Education Institution	Babeş-Bolyai University
1.2. Faculty	Faculty of Biology and Geology
1.3. Doctoral Shool	Doctoral School of Integrative Biology
1.4. Field of study	Biology
1.5. Level of study	Doctorate, 4 years

2. Course-related data

2.1. Course title	**Integrative Bioinformatics**			Course code	
2.2. Course coordinator	Cojocaru Vlad, PhD Habil., CS I Banciu Horia Leonard, PhD Habil., Prof.				
2.3. Seminar coordinator	Cojocaru Vlad, PhD Habil., CS I Banciu Horia Leonard, PhD Habil., Prof.				
2.4. Year of study	1	2.5. Semester	2	2.6. Type of assessment	Exam
2.7. Course status	Optional			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	**1**	3.3. seminar/ laboratory/ project	**3**
3.4. Total of hours in the curriculum	48	of which: 3.5. course	12	3.6. seminar/ laboratory	**36**
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					30
Preparing seminars/ laboratories/ projects, assignments, reports, portfolios, and essays					30
Tutoring (professional guidance)					24
Examinations					4
Other activities					9
3.7. Total hours of individual study (IS) and self-taught activities (ST)				**127**	
3.8. Total hours per semester				**175**	
3.9. Number of credits				**7**	

4. Prerequisites (where applicable)

4.1. curriculum-related	• Genetics, Cell and molecular biology	
4.2 skills-related	• Average computer skills	

5. Specific conditions (where applicable)

5.1. course-related	Beamer, blackboard; Internet connection; Online meeting platform	
5.2. seminar/laboratory-related	Attendance of at least 4 course/lecture activities. Attendance of 90% of practical/ seminar classes, Computers, specific development environment	

6. Subject-specific learning outcomes

Knowledge
1. Explains the principles of structural and environmental bioinformatics for the theoretical grounding of molecular and genomic analyses.
2. Analyzes the concepts and methods of structural modeling, molecular dynamics, and genome assembly for understanding the structure–function–evolution relationship.
3. Critically evaluates integrative paradigms that connect structural and genomic data for the mechanistic interpretation of biological processes..
Skills
1. Applies bioinformatics tools and Linux environments for the processing and analysis of structural and genomic data.
2. Develops structural models and genomic analysis workflows for investigating biomolecular function and microbial diversity.
3. Integrates multi-scale structural and genomic data for the formulation of testable biological hypotheses.
Responsibility and autonomy
1. Plans autonomously a bioinformatics analysis project for solving a complex scientific problem.
2. Critically argues the methodological validity of the obtained results to ensure scientific robustness.
3. Demonstrates professional responsibility in the use and reporting of bioinformatics data to guarantee reproducibility and research integrity.

7. Contents

7.1. Course	**Teaching and learning methods**	**Remarks**[1]
Structural Bioinformatics (part I) Introduction to Linux	Interactive exposure Presentation Explanation Practical examples Case-study discussions	Hybrid teaching: up to 40% onsite and up to 60% online classes
Structural Bioinformatics (part II) Visualization and analysis of biomolecular structures (e.g. proteins, nucleic acids)		
Structural Bioinformatics (part III) Molecular modelling (prediction of biomolecular structures, structure-based design)		
Structural Bioinformatics (part IV) Molecular docking, molecular dynamics simulations, free energy calculations		
Environmental Bioinformatics Elements of genomics, genomic projects, and databases. Genomic sequencing technologies; Quality control and read alignment; Genome assembly and comparison of assembly methods; Genome visualization tools: Dedicated genomic databases; Genome annotation; Taxonomic prediction of genomes		
Bibliography		
1. Keith J.M., Bioinformatics. Vol. 1: Data, sequence analysis, and evolution. New York : Humana Press, 2017.. In: Bioinformatics, vol. Vol. 1 2. Keith J.M., Bioinformatics. Vol. 2: Structure, function, and applications. New York : Humana Press, 2017.. In: Bioinformatics, vol. Vol. 2, 3. Leach, A.R. Molecular modelling: principles and applications. Pearson education.2001. 4. Pevzner P., Bioinformatics for biologists. Cambridge ; New York : Cambridge University Press, 2013 5. Stryer L., Biochemistry. New York : W. H. Freeman and Company, 1995\ 6. Schlick T., Molecular modeling and simulation : an interdisciplinary guide. New York, Springer, 2010.		

[1] For example, organisational aspects, recommendations for students, specific aspects relating to the course/seminar, such as inviting experts in the field, etc.

7. Xiong J., Essential bioinformatics. New York : Cambridge University Press, 2006 References (1-2, 4-5, 7) are available in printed format at the libraries of the Faculty of Biology and Geology. Reference (3) is available upon request from the class tutor. Reference (6) is available in printed format at the library of the Faculty of Chemistry and Chemical Engineering.

7.2. Seminar/ laboratory	**Teaching and learning methods**	**Remarks**
Study cases and exercises in structural bioinformatics (Modeling of three-dimensional structures of biomacromolecules; Comparison of 3D structures; Modelling and visualization of molecular dynamics; Data validation, integration and comparison)	Interactive explanations Explanation Conversation Study case-based learning	Hybrid teaching: up to 50% onsite and up to 50% online classes
Study cases and exercises in environmental bioinformatics: analysis of model genomes of microorganisms using online bioinformatics tools		
Presentation of a relevant scientific article	Active learning	
Testing the acquired practical skills	Evaluation	
Bibliography Collection of research articles available in digital format at the libraries of the Faculty of Biology and Geology and `Lucian Blaga` Central University Library, Cluj-Napoca.		

8. Evaluation

Type of activity	8.1 Evaluation criteria[2]	8.2 Evaluation methods[3]	8.3 Percentage in the final grade
8.4. Course	Conceptual explanation of structural and environmental bioinformatics principles; critical analysis of structural modeling, molecular dynamics, and genome assembly methodologies; critical evaluation of integrative structure–genome paradigms	Written exam	40%
8.5. Seminar/ laboratory	Critical methodological argumentation; evaluation of robustness and limitations; clarity and scientific coherence of presentation	Oral presentation and moderated scientific discussion	30%
	Autonomous planning of bioinformatics analysis; methodological justification; reproducibility and professional responsibility in data reporting	Written project report structured as a short scientific manuscript	30%
8.6 Minimum standard for passing			
Each student must obtain a minimum grade of "SUFFICIENT" (from the following list of available grades: INSUFFICIENT / SUFFICIENT / GOOD / VERY GOOD) in both the written examination and the seminar/laboratory assessment. In order to obtain the grade "SUFFICIENT," the student must demonstrate mastery of the fundamental concepts presented during the lectures and practical sessions.			

9. SDG labels (Sustainable Development Goals)[4]

[2] 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.

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

[4] 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

	○	Sustainable Development Generic Label

								
○	○	X	○	○	○	○	○	○
								No label applies
○	○	○	○	○	○	○	○	○

Date of entry:
20.02.2026

Signature of course coordinator

Cojocaru Vlad, PhD Habil., CS I

Banciu Horia Leonard, PhD Habil., Prof.

Signature of seminar coordinator

Cojocaru Vlad, PhD Habil., CS I

Banciu Horia Leonard, PhD Habil., Prof.

Date of approval in the department:
27.02.2027

Signature of the head of department

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the labels describe the subject, select the last option: *"No label applies."*