SYLLABUS

Structural and functional genomics

Academic year 2025-2026

1. Information regarding the programme

1.1. Higher education institution	Babeş-Bolyai University
1.2. Faculty	Faculty of Biology and Geology
1.3. Department	Department of Molecular Biology and Biotechnology
1.4. Field of study	Biology
1.5. Study cycle	Master, 4 semesters
1.6. Study programme/Qualification	Bioinformatics Applied in Life Sciences (English)/ Biologist
1.7. Form of education	Full-time

2. Information regarding the discipline

2.1. Name of the discipline	**Structural and functional genomics**					Discipline code	**BME 1121**
2.2. Course coordinator					Prof. Horia Leonard Banciu, PhD		
2.3. Seminar coordinator					Prof. Horia Leonard Banciu, PhD		
2.4. Year of study	1	2.5. Semester	2	2.6. Type of evaluation	E	2.7. Discipline regime	Mandatory

3. Total estimated time (hours/semester of didactic 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)					24
Additional documentation (in libraries, on electronic platforms, field documentation)					18
Preparation for seminars/labs, homework, papers, portfolios and essays					14
Tutorship					8
Evaluations					4
Other activities: two-way communication with the course holder / tutor					2
3.7. Total individual study hours	70				
3.8. Total hours per semester	126				
3.9. Number of ECTS credits	5				

4. Prerequisites (if necessary)

4.1. curriculum	Genetics, Biochemistry, Cell and molecular biology
4.2. competencies	Computer skills Ability to analyze, evaluate, and synthesize information in order to make informed decisions and solve problems logically and reasoned

5. Conditions (if necessary)

5.1. for the course	Online meeting platform Beamer, projection screen
5.2. for the seminar / lab activities	Attendance of a minimum of 90% of seminar classes is mandatory for granting the participation at the written exam. Computers, specific environment for developing and implementing bioinformatic pipelines/tools

6.1. Specific competencies acquired [1]

Professional/essential competencies	• The ability to explain the cellular phenotype as a consequence of the multidimensional interaction between genes, gene expression products, and gene translation within a specific context of cellular life. • The ability to use bioinformatics strategies, including sequencing, databases, and workflows, for the purpose of genomic analysis and genome functions. • The capacity to analyze, synthesize, and communicate specialized scientific information.
Transversal competencies	• The ability to clearly and convincingly communicate scientific results appropriately to the audience's level of understanding (specialists, the general public, or decision-makers). • Using theoretical concepts to solve practical problems. • The ability to analyze and interpret scientific data and formulate relevant conclusions based on it. • Understanding the ethical aspects and implications of biological and biomedical scientific research.

6.2. Learning outcomes

Knowledge	The student knows: • The fundamental principles of the organization and structure of viral, prokaryotic, and eukaryotic genomes, as well as the associated genomic databases. • Modern sequencing technologies and bioinformatics strategies used for genomic and functional gene analysis.
Skills	The student is able to: • Applying bioinformatics methods for the assembly, annotation, and comparison of genomes, using specialized resources and databases. • Analyzing interactions between genes, transcripts, and proteins, utilizing functional genomics methods for interpreting the cellular phenotype.
Responsibility and autonomy:	The student has the ability to work independently to obtain: • Develop and implement an individual project in genomic or functional genomic analysis, integrating advanced bioinformatics methods. • Document, interpret, and communicate the results of genomic analyses through the writing of scientific reports and presentations.

7. Objectives of the discipline (outcome of the acquired competencies)

7.1 General objective of the discipline	• Description of the organization and structure of genomes in viruses, prokaryotes, and eukaryotes, the modes of interaction between biological components that generate the cellular phenotype, as well as bioinformatics tools for the analysis of genomes and genome functions.
7.2 Specific objective of the discipline	• Knowledge of the main genomic sequencing technologies; • Understanding the general structure of viral, prokaryotic, and eukaryotic genomes; • Comprehension of the interactions between the components of a cellular biological network (genes, transcripts, proteins), as well as how these interactions contribute to the functioning of a cell; • Utilization of the main computational strategies for genomic analyses, comparative genomics, and functional genomics.

[1] One can choose either competences or learning outcomes, or both. If only one option is chosen, the row related to the other option will be deleted, and the kept one will be numbered 6.

8. Content

8.1 Course	Teaching methods	Remarks
Introduction to genomics – definitions, types of genomics, major genomic projects.	Frontal lecture; discussion.	2 hrs
Modern sequencing technologies –NGS, TGS, platform comparison, applications.	Frontal lecture; discussion; problem solving.	2 hrs
Genomic analysis strategies	Frontal lecture; discussion; case study.	2 hrs
Functional genomics using transcriptomics, proteomics, and epigenomics	Frontal lecture; discussion; case study.	4 hrs
Structure of viral, prokaryotic, and eukaryotic genomes – organization, specific features, dedicated databases.	Frontal lecture; discussion; problem solving.	10 hrs
Comparative and evolutionary genomics – comparison methods, molecular phylogeny, evolutionary mechanisms.	Frontal lecture; discussion; problem solving.	2 hrs
Medical genomics and personalized medicine	Frontal lecture; discussion; problem solving.	2 hrs
Environmental genomics and metagenomics	Frontal lecture; discussion; case study.	2 hrs
Biotechnological applications of genomics	Frontal lecture; discussion; case study.	2 hrs
Bibliography Bernardi, G. Structural and Evolutionary Genomics. Natural Selection in Genome Evolution, Elsevier, Amsterdam, 2005. Caetano-Anolles Gustavo, Evolutionary genomics and systems biology. Hoboken, N. J. : Wiley-Blackwell, 2010. Craig N.L., Cohen-Fix O., Green R., Molecular biology : principles of genome function. Oxford University Press, 2010. Lesk A.M., Introduction to genomics. Oxford : Oxford University Press, 2017 Lynch, M. The origins of Genome Architecture, Sinauer Assoc., Sunderland, 2007. Mülhardt, Cornel, Molecular biology and genomics. Academic Press, Amsterdam, 2007 Watson J.D., Baker T.A., Bell S.P., Molecular biology of the gene. Cold Spring Harbor Laboratory Press, 2008 Slides (pdf) are provided to the students through the dedicated team channel within MS Teams application.		
8.2 Seminar / laboratory	Teaching methods	Remarks
Organizing and introducing seminar tasks	Discussion	2 hrs
Bioinformatic workflows for analysing viral, prokaryotic, and eukaryotic genomes – applied lessons	Eurystic conversation; discussion, problem solving.	22 hrs
Session for making up missed activities (week 11 or 13)		2 hrs
Evaluation of written colloquium based on the gained knowledge during seminars	Evaluation	2 hrs
Bibliography Hunt S., Functional genomics : a practical approach. Oxford : Oxford University Press, 2002. Xu S., Principles of statistical genomics. New York : Springer, 2013 Online resources and scientific papers (as pdf) available through the University librairies as open access or paid online subscription to main publishers.		

9. Corroborating the content of the discipline with the expectations of the epistemic community, professional associations and representative employers within the field of the program

- The course enables the acquisition of theoretical and practical skills necessary for teamwork in the research and development field within academic entities, as well as in R&D units of private companies.
- The course is included in the curricula of similar specializations at universities bothRomanian and foreign.

10. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of final grade
10.4 Course	Knowledge of information from the topics of the course	Written exam	50 %
	Accuracy, coherence, and organization of responses. The ability to analyze and interpret.		
10.5 Seminar/laboratory	Skills to understand and synthesize scientific information.	Written colloquium	50%
	Accuracy, coherence, and organization of responses.		
	Skills for presenting/ communicating scientific information		
10.6 Minimum standard of performance			
• Obtaining a minimum grade of 5.00 (five) both on the written exam and in the final average for the course. • Completion and submission of at least one assigned task during the course, in accordance with the established requirements.			

11. Labels ODD (Sustainable Development Goals)[2]

	General label for Sustainable Development							
								
								

Date:
08.01.2025

Signature of course coordinator

Prof. Horia Banciu, PhD

Signature of seminar coordinator

Prof. Horia Banciu, PhD

Date of approval:
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Signature of the head of department

Assoc. Prof. Beatrice Kelemen, PhD

[2] Keep only the labels that, according to the *Procedure for applying ODD labels in the academic process*, suit the discipline and delete the others, including the general one for *Sustainable Development* – if not applicable. If no label describes the discipline, delete them all and write „*Not applicable.*”.