SYLLABUS

Bioinformatic methods for microbial genomics and transcriptomics

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	**Bioinformatic methods for microbial genomics and transcriptomics**					Discipline code	**BME 1135**
2.2. Course coordinator					Prof. Horia Leonard Banciu, PhD		
2.3. Seminar coordinator					Prof. Horia Leonard Banciu, PhD		
2.4. Year of study	2	2.5. Semester	3	2.6. Type of evaluation	E	2.7. Discipline regime	Optional

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	Cell and molecular biology, Structural and functional genomics
4.2. competencies	Computer skills and Linux proficiency 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	• Developing the ability to explain the phenotype (including pathogenicity), diversity, and physiology of microorganisms in a genomic and environmental context. • The capacity to analyze and interpret microbial genomic and transcriptomic data using bioinformatics tools. • Skills in querying public genomic databases to perform microbial data analyses at the population level. • 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 ofmicrobial genomes, as well as the associated genomic databases. • Modern sequencing technologies and bioinformatics strategies used for genomic and functional gene analysis in microorganisms.
Skills	The student is able to: • Applying bioinformatics methods for the assembly, annotation, and comparison of microbial genomes, using specialized resources and databases. • Analyzing interactions between genes, transcripts, and proteins, utilizing functional genomics methods for interpreting themicrobialr 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 for microorganisms, integrating advanced bioinformatics methods. • Document, interpret, and communicate the results of microbial 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 microbial genomes in the cellular context and as result of interactions between genetic information and changing environmental conditions.
7.2 Specific objective of the discipline	• Analysis of the diversity and organization of microbial genomes to understand mechanisms of evolution and adaptation. • Application of bioinformatics methods for genome annotation and microbial gene expression analysis. • Investigation of pathogenicity and antimicrobial resistance through genomic and transcriptomic techniques. • Development of practical bioinformatics skills for genomic data interpretation and infectious disease diagnosis..

[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 microbial genomics and transcriptomics (fundamental principles, microbial genome diversity, and sequencing technologies)	Frontal lecture; discussion.	4 hrs
Sequencing methods and data preprocessing (NGS technologies, sequence quality control, and genome assembly)	Frontal lecture; discussion; problem-based learning,	4 hrs
Annotation and comparative analysis of microbial genomes	Frontal lecture; discussion; case study.	4 hrs
Transcriptomic analysis and gene expression regulation (RNA-seq, identification of regulatory pathways, and stress response)	Frontal lecture; discussion; case study.	4 hrs
Functional genomics and bioinformatics for pathogens (identification of virulence factors, resistance mechanisms, and host-pathogen interactions)	Fro Frontal lecture; discussion; problem-based learning, case study	4 hrs
Bioinformatics applications in epidemiology and molecular diagnostics (traceability of pathogens, phylogenetic analysis, and the use of genomic data in public health)	Frontal lecture; discussion; problem-based learning, case study	4 hrs
Metagenomics and metatranscriptomics	Frontal lecture; discussion; problem-based learning, case study	4 hrs
Bibliography 1. Lesk A.M., Introduction to genomics. Oxford : Oxford University Press, 2017 2. Madigan M.T., Martinko J.M., Bender K.S., Brock biology of microorganisms. Boston ; Columbus ; Indianapolis ; [etc.] : Pearson, 2015. 3. McArthur J.V., Microbial ecology : an evolutionary approach. Amsterdam ; Boston ; Heidelberg ; [etc.] : Elsevier : Academic Press, 2006 4. Zhou J., Thompson D.K., Xu Y., Tiedje J.M., Microbial functional genomics. Hoboken, N.J. : Wiley-Liss, 2004. The above books are available in hard copies at the libraries of the Faculty of Biology and Geology.		
8.2 Seminar / laboratory	Teaching methods	Remarks
Organizing and introducing seminar tasks	Discussion	2 hrs
Bioinformatic workflows for analyzing microbial genomes – practical lessons	Problem-solving, exemplification, demonstration, case study.	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 Rochelle P.A., Environmental molecular microbiology : protocols and applications. Norfolk : Horizon Scientific Press, 2001. Online resources and scientific papers (as pdf) available through the University libraries 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.*”.