SYLLABUS

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**
1.6 Study programme / Qualification	**Bioinformatics applied in life sciences**

2. Information regarding the discipline

2.1 Name of the discipline (en) (ro)			**Biological networks and systems** **Rețele biologice și sistemice**				
2.2 Course coordinator			**Assist. prof. dr. László Zoltán**				
2.3 Seminar coordinator			**Assist. prof. dr. László Zoltán**				
2.4. Year of study	**2**	2.5 Semester	**3**	2.6. Type of evaluation	**E**	2.7 Type of discipline	**Elective**
2.8. Code of the discipline		**BMR1138**					

3. Total estimated time (hours/semester of didactic activities)

3.1 Hours per week	**4**	Of which: 3.2 course	**2**	3.3 seminar/laboratory	**2**
3.4 Total hours in the curriculum	**56**	Of which: 3.5 course	**28**	3.6 seminar/laboratory	**28**
Time allotment:					hours
Learning using manual, course support, bibliography, course notes					24
Additional documentation (in libraries, on electronic platforms, field documentation)					18
Preparation for seminars/labs, homework, papers, portfolios and essays					16
Tutorship					8
Evaluations					4
Other activities:					

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	
4.2. competencies	• Average computer skills

5. Conditions (if necessary)

5.1. for the course	• Beamer • Online meeting platform
5.2. for the seminar /lab activities	• Attendance of a minimum of 90% of practical/ seminar classes, • Computers, specific development environment

6. Specific competencies acquired

Professional competencies	• Develop an understanding of how networks control biological processes and how they evolve in response to external factors as well as evolutionary processes. • Descriptions of the algorithms and methods by which biological networks can be studied, with the use of computer code.
Transversal competencies	• Efficient conduct of activities organized in an interdisciplinary group • Using the specific concepts of network biology to interpret the results or solve theoretical and experimental problems

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

7.1 General objective of the discipline	• Description of analytical methods and downstream data processing, integration and visualization regarding biological networks
7.2 Specific objective of the discipline	• Description of main techniques, data acquisition and processing strategies • Understanding the principles underlying the biological networks • Knowledge of main types of biological networks • Applying tools for data processing and visualization regarding biological networks

8. Content

8.1 Course	Teaching methods	Remarks
Introduction	• Interactive exposure • Presentation • Explanation • Practical examples • Case-study discussions	
Graph theory		
Random and non – random networks		
Different network types and their use in biology		
Evolving networks and modells		
Degree correlations		
Network robustness and stability		
Communities as networks		
Spreading phenomena		

Bibliography

1. Barabási, A. L. (2013). Network science. In Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences (Vol. 371, Issue 1987). https://doi.org/10.1098/rsta.2012.0375
2. May, R. M. (1972). Will a large complex system be stable? Nature, 238(5364). https://doi.org/10.1038/238413a0
3. May, R. M. (2001). Stability and Complexity in Model Ecosystems. In The Journal of Animal Ecology (Vol. 44, Issue 3). Princeton University Press. https://doi.org/10.1515/9780691206912
4. Newman, M. E. J., Barabási, A. L., & Watts, D. J. (2011). The structure and dynamics of networks. In The Structure and Dynamics of Networks (Vol. 9781400841356). https://doi.org/10.1007/s10955-006-9267-8
5. PIMM, S. L., & LAWTON, J. H. (1978). On feeding on more than one trophic level. Nature, 275(5680), 542–544. https://doi.org/10.1038/275542a0

8.2 Seminar / laboratory	Teaching methods	Remarks
Introduction to R	• Interactive exposure • Explanation • Conversation • Practical demonstration	
Network generation using R		
Network topology and metrics		
Network dynamics		
Lotka-Volterra models		
Simulations, stability and complexity		

Network visualization		

Bibliography

1. The R Project for Statistical Computing [http://www.R-project.org/
2. Almende B.V. and Contributors, Benoit Thieurmel and Titouan Robert (2021). visNetwork: Network Visualization using 'vis.js' Library. R package version 2.1.0. https://CRAN.R-project.org/package=visNetwork
3. Csardi G, Nepusz T: The igraph software package for complex network research, InterJournal, Complex Systems 1695. 2006. https://igraph.org
4. Dormann, C.F., Fruend, J., Bluethgen, N. & Gruber B. 2009. Indices, graphs and null models: analyzing bipartite ecological networks. The Open Ecology Journal, 2, 7-24.
5. Dormann, C.F., Gruber B. & Fruend, J. (2008). Introducing the bipartite Package: Analysing Ecological Networks. R news Vol 8/2, 8 - 11.
6. Dormann, C.F. (2011). How to be a specialist? Quantifying specialisation in pollination networks. Network Biology 1, 1 - 20.
7. Thomas Lin Pedersen (2021). ggraph: An Implementation of Grammar of Graphics for Graphs and Networks. R package version 2.0.5. https://CRAN.R-project.org/package=ggraph

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 promotes the gaining of theoretical knowledge and practical skills required for teamwork in the field of research and development in academic entities, but also in R&D units in private companies;
- The course is listed in the curriculum of similar specializations at Romanian and foreign Universities.

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share in the grade (%)
10.4 Course	Knowledge of concepts and methods from the topics of the course	Written exam (combined test)	50%
10.5 Seminar/lab activities	Evaluation of a short individual project	Oral colloquium	50%
10.6Minimum performance standards			
Each student should obtain minimum 5 at the written exam and oral colloquium. In order to obtain the minimum grade 5, the student must demonstrate the mastery of the basic concepts described during the course and practicum classes.			

Date	Signature of course coordinator	Signature of seminar coordinator
14.01.2022	**Assist. Prof. dr. László Zoltán**	**Assist. Prof. dr. László Zoltán**

Date of approval	Signature of the head of department
18.01.2022	**Assoc. Prof. Beatrice Kelemen**