SYLLABUS

1. Information regarding the programme

1.1 Higher education institution	**Babeş Bolyai University**
1.2 Faculty	**Faculty of Mathematics and Computer Science**
1.3 Department	**Department of Computer Science**
1.4 Field of study	**Computer Science**
1.5 Study cycle	**Bachelor**
1.6 Study programme / Qualification	**Computer Science – English**

2. Information regarding the discipline

2.1 Name of the discipline (en) (ro)			**Complex Networks**				
2.2 Course coordinator			**Conf. Dr. Camelia Chira**				
2.3 Seminar coordinator			**Conf. Dr. Camelia Chira**				
2.4. Year of study	**3**	2.5 Semester	**5**	2.6. Type of evaluation	**C**	2.7 Type of discipline	**Optional**
2.8 Code of the discipline		MLE5116					

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	1 lab + 1 project
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					10
Additional documentation (in libraries, on electronic platforms, field documentation)					12
Preparation for seminars/labs, homework, papers, portfolios and essays					14
Tutorship					4
Evaluations					4
Other activities:					

3.7 Total individual study hours	44
3.8 Total hours per semester	100
3.9 Number of ECTS credits	4

4. Prerequisites (if necessary)

4.1. curriculum	• Algorithms and Programming, OOP
4.2. competencies	• Good programming skills

5. Conditions (if necessary)

5.1. for the course	• Projector
5.2. for the seminar /lab activities	• Computers, Network visualization tools, Python/Java/C++ programming environment

6. Specific competencies acquired

Professional competencies	C1. Description of concepts, principles and methods used in the interdisciplinary field of complex network science C2. Use of mathematical and computer science models and tools for solving problems in the application domain C3. Modern theory and applications of complex networks C4. Network data analysis
Transversal competencies	TC1. Application of efficient work rules and responsible attitudes towards the scientific domain, for the creative exploitation of one's own potential according to the principles and rules of professional ethics TC2. Efficient conduct of activities organized in an interdisciplinary group and development of empathic capacity of interpersonal communication, networking and collaboration with diverse groups TC3. Use of efficient methods and techniques for learning, information, research and development of abilities for knowledge exploitation, for adapting to the needs of a dynamic society and for communication in a widely used foreign language.

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

7.1 General objective of the discipline	• Introduce the interdisciplinary academic field of network science and the modern theory and applications of complex networks
7.2 Specific objective of the discipline	• Describe the concepts and methods used in network science, define network models (scale-free, small-world, power-law) and processes on networks, theory and modelling of complex networks, analysis of real-world network datasets.

8. Content

8.1 Course	Teaching methods	Remarks
1. Introduction to Complexity and Network Science. Real-world networks: concepts, challenges	• Interactive exposure • Presentation • Explanation • Practical examples • Case-study discussions	
2. Study of networks: social networks, technological networks, information networks, biological networks, economic networks		
3. Network properties and metrics, large-scale structure of networks		
4. Network theory: node degree, paths, degree distribution, measures and metrics (connectedness, clustering coefficient, shortest paths)		
5. Network centrality (degree centrality, betweenness centrality, closeness centrality, eigenvector centrality)		
6. Network communities		
7. Network models: random graphs, power-law and scale-free networks, small worlds, network formation, network visualization		
8. Network dynamics		
9. Network functions and behaviours (cascades and epidemics, network structure balance)		
10. Information diffusion		
11. Real-world networks (examples, social networks)		
12. -14. Student presentations		

Bibliography

- Albert-Laszlo Barabasi, Network Science, Cambridge University Press, 2016.
- Mark Newman, Networks: An Introduction, Oxford University Press, 2010.
- David Easley and Jon Kleinberg, Networks, Crowds, and Markets: Reasoning About a Highly Connected World, Cambridge University Press, 2010.
- Ernesto Estrada, The Structure of Complex Networks Theory and Applications, Oxford University Press, 2011.
- Melanie Mitchell, Complexity: A Guided Tour, Oxford University Press, 2009.

8.2 Seminar / laboratory	Teaching methods	Remarks
1. Graph representation of networks. Adjacency matrix, link lists	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
2. Network analysis: degree, clustering coefficient		
3. Network analysis and visualization: centrality, betweenness, closeness		
4. Network models: random graphs, small worlds, power-law		
5. Properties of networks: communities		
6. Diffusion in networks		
7. Student presentations		

Bibliography

- Albert-Laszlo Barabasi, Network Science, Cambridge University Press, 2016.
- Mark Newman, Networks: An Introduction, Oxford University Press, 2010.
- David Easley and Jon Kleinberg, Networks, Crowds, and Markets: Reasoning About a Highly Connected World, Cambridge University Press, 2010.
- Ernesto Estrada, The Structure of Complex Networks Theory and Applications, Oxford University Press, 2011.
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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 exists in the studying program of all major universities abroad;

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share in the grade (%)
10.4 Course	Know basic concepts, models and theories on network science	Presentation of individual project	50%
10.5 Seminar/lab activities	Network data analysis	Laboratory work	50%
10.6 Minimum performance standards			
➢ Minimum 5 as the final grade.			

Date	Signature of course coordinator	Signature of seminar coordinator
17.04.2018	Conf. dr. Camelia Chira	Conf. dr. Camelia Chira

Date of approval

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Signature of the head of department

Prof. dr. Anca Andreica