SYLLABUS

1. Information regarding the programme

1.1 Higher education institution	**Babes Bolyai University**
1.2 Faculty	**Mathematics and Computer Science Faculty**
1.3 Department	**Computer Science Department**
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)			**Advanced methods for solving mathematical and algorithmic problems** / Metode avansate de rezolvare a problemelor de matematică şi informatică				
2.2 Course coordinator			**Asist. Dr. Mircea Ioan-Gabriel**				
2.3 Seminar coordinator			**Asist. Dr. Mircea Ioan-Gabriel**				
2.4. Year of study	**1**	2.5 Semester	**2**	2.6. Type of evaluation	**C**	2.7 Type of discipline	**F**
2.8 Code of the discipline		MLR2002	**FACULTATIVE**				

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	2
Additional documentation (in libraries, on electronic platforms, field documentation)	0
Preparation for seminars/labs, homework, papers, portfolios and essays	10
Tutorship	5
Evaluations	2
Other activities:	

3.7 Total individual study hours	19
3.8 Total hours per semester	75
3.9 Number of ECTS credits	3

4. Prerequisites (if necessary)

4.1. curriculum	•
4.2. competencies	•

5. Conditions (if necessary)

5.1. for the course	•
5.2. for the seminar / lab activities	•

6. Specific competencies acquired

Professional competencies	C 4.2 The formal interpretation of mathematical and computer science related models (formal) C 4.3 The identification of advanced methods and models for solving real problems
Transversal competencies	CT1 Application of efficient and rigorous working rules, manifest responsible attitudes toward the scientific and didactic fields, respecting the professional and ethical principles. CT2 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 Romanian as well as in a widely used foreign language CT3 Use of efficient methods and techniques to learn, inform, research and develop the abilities to value the knowledge, to adapt to requirements of a dynamic society and to communicate in Romanian language and in a language of international circulation

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

7.1 General objective of the discipline	• The theoretical and practical training of student teams for computer science competitions
7.2 Specific objective of the discipline	• Understanding and properly applying • specific data structures • fundamental algorithms and solving methods • team work • in-competition time management • in the context of student computer science problem solving competitions

8. Content

8.1 Course	Teaching methods	Remarks
1. (weeks 1-2) : Searching and sorting - binary search - quick sort - merge sort - heap sort - counting sort - KMP	Interactive exposure Explanation Conversation Didactical demonstration	
2. (weeks 2-4) : Relevant data structures - Binary Indexed Tree - Interval Tree - Tries	Interactive exposure Explanation Conversation Didactical	

- Finite Automata - AVL Trees - Disjoint Sets	demonstration	
3. (weeks 5-6) : Graph Algorithms - BFS, DFS - Dijkstra, Floyd-Warshall - Prim, Kruskal - DAGs, Topological sorting - Bridges in graphs, Strongly-connected components	Interactive exposure Explanation Conversation Didactical demonstration	
4. (weeks 7-8) : Dynamic Programming - longest common subsequence - edit distance - Needleman-Wunsch	Interactive exposure Explanation Conversation Didactical demonstration	
5. (weeks 9-10) : Mathematical methods applied in computer science - Number theory - Combinatorics - Approximation methods	Interactive exposure Explanation Conversation Didactical demonstration	
6. (weeks 11-13) : Geometry and Networks - convex hull - Ford Fulkerson - bipartite graphs - LCA and RMQ - Hopcroft-Karp	Interactive exposure Explanation Conversation Didactical demonstration	
7. Review and Evaluation		

Bibliography

1. DONALD E. KNUTH, The Art of Computer Programming, Addison-Wesley, 1998
2. DONALD E. KNUTH, The Stanford GraphBase : A Platform for Combinatorial Computing, ACM Press / Addison-Wesley, 1993.
3. STEVEN SKIENA and MIGUEL REVILLA, Programming Challenges : The Programming Contest Training Manual, Springer-Verlag, 2003.
4. DAVID HAREL, Algorithmics : The Spirit of Computing, 3rd edition, Addison-Wesley, 2004.

8.2 Seminar / laboratory	Teaching methods	Remarks
1. The labs will follow the same content taught at the lecture by applying the newly taught notions for solving actual programming contest problems	Lab assignment Explanation Conversation	
2. The students may propose interesting problems as well especially if they bring up new areas that have not been tackled so far	Lab assignment Explanation Conversation	
3. If the online rounds of the major programming competitions synchronize with the lab the teams will be competing in those online stages	Lab assignment Explanation Conversation	

Bibliography

http://www.infoarena.ro/
http://codeforces.com/
https://www.hackerrank.com/
https://www.hackerearth.com/challenges/

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 complies to the IEEE and ACM Curriculla Recommendations for Computer Science studies. • The Course complies to the requirements of ACM-ICPC competitions

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share in the grade (%)
10.4 Course	Proper understanding of the theoretical and practical aspects of the subject	Written paper	25%
	Properly solving the proposed problems		
10.5 Seminar / lab activities	Properly solving programming problems during labs and in competitions		75%
10.6 Minimum performance standards			
• Minimum 5 grade for the lab activity			

Date	Signature of course coordinator	Signature of seminar coordinator
16.04.2018	Asist. Dr. Mircea Ioan-Gabriel	Asist. Dr. Mircea Ioan-Gabriel

Date of approval	Signature of the head of department
.....	Prof. Dr. Andreica Anca