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 Mathematics
1.4 Field of study	Computer Science
1.5 Study cycle	Master
1.6 Study programme / Qualification	Software Engineering

2. Information regarding the discipline

2.1 Name of the discipline			Mathematical foundations of the decision-making process				
2.2 Course coordinator			Assoc. Prof. Nicolae Popovici, Ph.D.				
2.3 Seminar coordinator			Assoc. Prof. Nicolae Popovici, Ph.D.				
2.4. Year of study	1	2.5 Semester	1	2.6. Type of evaluation	Exam	2.7 Type of discipline	Compulsory

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

3.1 Hours per week	3	Of which: 3.2 course	2	3.3 seminar	1
3.4 Total hours in the curriculum	42	Of which: 3.5 course	28	3.6 seminar	14
Time allotment:					Hours
Learning using manual, course support, bibliography, course notes					63
Additional documentation (in libraries, on electronic platforms, field documentation)					7
Preparation for seminars/labs, homework, papers, portfolios and essays					21
Tutorship					7
Evaluations					35
Other activities:					-

3.7 Total individual study hours	133
3.8 Total hours per semester	175
3.9 Number of ECTS credits	7

4. Prerequisites (if necessary)

4.1. curriculum	• Algebra • Geometry • Mathematical Analysis
4.2. competencies	Basic notions of linear algebra, analytical geometry and differential calculus in the n-dimensional Euclidean space

5. Conditions (if necessary)

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

6. Specific competencies acquired

Professional competencies	• Ability to understand and manipulate advanced concepts and results in the field of optimization theory. • Ability to use mathematical methods for solving optimization problems.
Transversal competencies	• Ability to model and analyze from a mathematical point of view practical decision-making processes from other sciences, economics and engineering.

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

7.1 General objective of the discipline	The study of fundamental mathematical concepts and practical methods relevant to the decision-making processes.
7.2 Specific objective of the discipline	Students should acquire knowledge about: • Partially ordered sets; • Convex sets, cones and convex functions; • Scalar optimization; • Vector (multicriteria) optimization.

8. Content

8.1 Course	Teaching methods	Remarks
1. Partially ordered sets.	Direct instruction, mathematical proof, exemplification	
2. Convex sets and cones.	Direct instruction, mathematical proof, exemplification	
3. Convex functions.	Direct instruction, mathematical proof, exemplification	
4. Preference relations induced by a scalar function. Scalar optimization problems.	Direct instruction, mathematical proof, exemplification	
5. Characterization of optimal solutions by means of level sets. Existence and unicity of optimal solutions.	Direct instruction, mathematical proof, exemplification	
6. Sufficient and necessary optimality conditions.	Direct instruction, mathematical proof, exemplification	
7. Partially ordered linear spaces.	Direct instruction, mathematical proof, exemplification	
8. Preference relations induced by a vector function. Vector (multicriteria) optimization problems.	Direct instruction, mathematical proof, exemplification	
9. Characterization of strongly/ weakly efficient solutions by means of level sets. Existence of efficient solutions..	Direct instruction, mathematical proof, exemplification	

10. Sufficient and necessary conditions for strong/weak efficiency.	Direct instruction, mathematical proof, exemplification	
11. Scalarization methods.	Direct instruction, mathematical proof, exemplification	
12. Proper efficient solutions, compromise solutions.	Direct instruction, mathematical proof, exemplification	
13. The structure of efficiency sets in the outcome/decision space.	Direct instruction, mathematical proof, exemplification	
14. Decomposition of multicriteria optimization problems.	Direct instruction, mathematical proof, exemplification	

Bibliography

1. ANDERSON, D.R., SWEENEY, D.J., WILLIAMS, T.A., An Introduction to Management Science. Quantitative Approaches to Decision Making, South-Western College Publishing, Cincinnati, 2000.
2. BRECKNER, B.E., POPOVICI, N.: Convexity and Optimization. An Introduction, EFES, Cluj-Napoca, 2006.
3. BRECKNER, W.W.: Cercetare operaţională, Universitatea Babeş-Bolyai, Cluj-Napoca, 1981.
4. POPOVICI, N.: Optimizare vectoriala, Casa Cartii de Stiinta, Cluj-Napoca, 2005.
5. VANDERBEI, R.: Linear Programming. Foundations and Extensions, Springer, Boston, 2008.
6. YU, P.L.: Multiple Criteria Decision Making: Concepts, Techniques and Extensions, Plenum Press, New York - London, 1985.

8.2 Seminar	Teaching methods	Remarks
1. Preorder relations.	Problem-based instruction, debate, mathematical proofs	2 hours
2. Convex sets and cones.	Problem-based instruction, debate, mathematical proofs	2 hours
3. Convex functions.	Problem-based instruction, debate, mathematical proofs	2 hours
4. Geometric interpretation of the level sets.	Problem-based instruction, debate, mathematical proofs	2 hours
5. Scalar optimization problems solved by a geometric approach	Problem-based instruction	2 hours
6. Scalar optimization problems solved by means of optimality conditions.	Problem-based instruction, debate, mathematical proofs	2 hours
7. Multicriteria optimization problems solved by a geometric approach.	Problem-based instruction, debate, mathematical proofs	2 hours

Bibliography

1. BRECKNER, B.E., POPOVICI, N.: Probleme de cercetare operationala, EFES, Cluj-Napoca, 2006.
2. BRECKNER, W.W., DUCA, D.: Culegere de probleme de cercetare operationala, Universitatea Babes-Bolyai, Facultatea de Matematica, Cluj-Napoca, 1983.
3. MORDUKHOVICH, B.S., NAM, N.M., An easy path to convex analysis and applications, Morgan & Claypool Publishers, Milton Keynes, 2014.
4. POPOVICI, N.: Optimizare vectoriala, Casa Cartii de Stiinta, Cluj-Napoca, 2005.

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 ensures a solid theoretical background, according to national and international standards

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share in the grade (%)
10.4 Course	- Knowledge of theoretical concepts and capacity to rigorously prove the main theorems; - Ability to solve practical exercises and theoretical problems	Written exam	70%
10.5 Seminar/lab activities	Attendance and active class participation	Continuous evaluation	30%
10.6 Minimum performance standards			
The final grade should be greater than or equal to 5.			

Date	Signature of course coordinator	Signature of seminar coordinator
15.04.2016	Assoc. Prof. Nicolae Popovici, Ph.D.	Assoc. Prof. Nicolae Popovici, Ph.D.

Date of approval	Signature of the head of department
.....	Prof. Octavian Agratini, Ph.D.