SYLLABUS

Operations Research

University year 2025-2026

1. Information regarding the programme

1.1. Higher education institution	Babeș-Bolyai University
1.2. Faculty	Mathematics and Computer Science
1.3. Department	Computer Science
1.4. Field of study	Computer Science
1.5. Study cycle	Master
1.6. Study programme/Qualification	Artificial Intelligence for Connected Industries
1.7. Form of education	Full time

2. Information regarding the discipline

2.1. Name of the discipline	**Operations Research**					Discipline code	
2.2. Course coordinator					Assoc.prof.phd. Mihai SUCIU		
2.3. Seminar coordinator					Assoc.prof.phd. Mihai SUCIU		
2.4. Year of study	1	2.5. Semester	1	2.6. Type of evaluation	E	2.7. Discipline regime	Mandatory

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

3.1. Hours per week		of which: 3.2 course		3.3 seminar/laboratory/project	
3.4. Total hours in the curriculum		of which: 3.5 course		3.6 seminar/laboratory/project	

Time allotment for individual study (ID) and self-study activities (SA)	**hours**
Learning using manual, course support, bibliography, course notes (SA)	28
Additional documentation (in libraries, on electronic platforms, field documentation)	30
Preparation for seminars/labs, homework, papers, portfolios and essays	30
Tutorship	4
Evaluations	5
Other activities:	0
3.7. Total individual study hours	**94**
3.8. Total hours per semester	**150**
3.9. Number of ECTS credits	**6**

4. Prerequisites (if necessary)

4.1. curriculum	· Data Structures and Algorithms
4.2. competencies	· Basic knowledge of data structures and algorithms. Basic python and/or Julia programming.

5. Conditions (if necessary)

5.1. for the course	· course room with video projector and whiteboard
5.2. for the seminar /lab activities	· course room with video projector and whiteboard

6.1. Specific competencies acquired [1]

[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.

Professional/essential competencies	• Ability to apply knowledge of computing and mathematics appropriate to the discipline; • Ability to analyse a problem, and identify and define the computing requirements appropriate to its solution; • Ability to identify and to specify computing requirements of an application and to design, implement, evaluate, and justify computational solutions; • Ability to use current techniques and skills to integrate available theory and tools necessary for applied computing practices.
Transversal competencies	• Good English communication skills; • Professional communication skills; concise and precise description, both oral and written, of professional results; • Ethic and fair behavior, commitment to professional deontology.

6.2. Learning outcomes

Knowledge	The student possesses the fundamental knowledge for modelling, being able to analyse real life problems and to translate them in concrete requirements and to design a corresponding software model; knows and respects the ethical and legal principles and rules in scientific research.
Skills	The student has the skills to perform research in the domain of educational sciences especially for algorithmic thinking and for critical thinking; uses efficient strategies, methods and techniques for lifelong education, in order to self educate and self develop his/her personal and professional skills.
Responsibility and autonomy:	The student has the ability to work independently in order to obtain knowledge necessary for designing, managing and evaluating research activities.

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

7.1 General objective of the discipline	The course is an introduction to operations research tools for network applications. Emphasis will be on model formulations, linear and integer linear programming with the main objective of solving practical applications. The course will also provide an integrated view of algorithms and applications of key network optimization problems
7.2 Specific objective of the discipline	The course is aimed at providing the participants with knowledge in applied optimization, with a focus on applying theory and methods in key network optimization problems.

8. Content

8.1 Course	Teaching methods	Remarks
Introduction to Operations Research		

Introduction to Foundation mathematics and statistics	Exposure: description, explanation, examples, debate	
Linear Programming		
Maximization Then Minimization problems.		
Graphical LP Minimization solution, Introduction, Simplex method definition, formulating the Simplex model		
Linear Programming – Simplex Method for Maximizing.		
Transportation model		
Network model		
Advanced linear programming, Integer linear programming		
Metaheuristics Optimization Algorithms		
Multi-objective optimization		
Optimization with engineering Applications, as for example Routing and traffic management, Network design, Network connectivity and reliability, Energy consumption consideration in network optimization.		
Use cases extracted from research papers.		
Use cases extracted from research papers.		

Bibliography

1. S. Dasgupta, C. Papadimitriou, and U. Vazirani. Algorithms. McGraw-Hill, 2006
2. Network flows Ravindra K. Ahuja, Thomas L. Magnanti, and James B. Orlin, 1988
3. Integer Programming Laurence Wolsey, 1998
4. A.D. Belegundu, T.R. Chandrupatla, "Optimization Concepts and Applications in Engineering," Second Edition. Cambridge University Press, 2nd Edition, 2011
5. B. Guenin, J. Knemann, L. Tunel, "A gentle Introduction to Optimization," Cambridge University Press, 2014
6. E. Oki, "Linear Programming and Algorithms for Communication Networks," CRC Press, 2013
7. D. Simon "Evolutionary Optimization Algorithms. Biologically Inspired and Population-Based Approaches to Computer Intelligence," John Wiley & Sons, Inc., 4th Edition, 2013
8. Edwin K. P. Chong, Wu-Sheng Lu, and Stanislaw H. Żak. "An Introduction to Optimization, Fifth Edition With Applications to Machine Learning," John Wiley & Sons, Inc. New York, 2023

8.2 Seminar / laboratory	Teaching methods	Remarks
Problem definition, unconstrained optimization, constrained optimization	Dialogue, debate, examples, guided discovery	
Modeling combinatorial optimization problems		
Linear programming, Integer and mixed-integer linear programming.		
Optimization with engineering applications		
Metaheuristics		
Multiobjective optimization		
Different use cases		

Bibliography

1. Mykel J. Kochenderfer, Tim A. Wheeler. Algorithms for Optimization, MIT press, 2019
2. Mykel J. Kochenderfer, Tim A. Wheeler, Kyle H. Wray. Algorithms for Decision Making, MIT Press, 2022
3. D. Simon "Evolutionary Optimization Algorithms. Biologically Inspired and Population-Based Approaches to Computer Intelligence," John Wiley & Sons, Inc., 4th Edition, 2013
4. D. P. Bertsekas, "Network Optimization. Continuous and discrete models," Athena Scientific, 1998.

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

It is carried out through regular discussions with representatives of significant employers in the field of computer science.

Courses on operations research are taught at universities in the country and abroad.

10. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of final grade
10.4 Course	Basic elements of operations research and its applications.	Written exam	
10.5 Seminar/laboratory	- apply the course concepts - problem solving	Practical exam or projects	
10.6 Minimum standard of performance			

- Grade: minimum 5 at each grading activity.
- Attendances: 75% attendance at seminar activities.
- Students with more than 2 unmotivated absences at the seminar will not be able to take the exam in the normal session and or in the retake examination session (seminar activities are activities that take place on the following principle "activity along the semester ", and they cannot be recovered or repeated for a possible retake examination (these students will have to repeat this course in the next academic year)). Students with medical certificates for each of their absences are exempted from this rule.

11. Labels ODD (Sustainable Development Goals)[2]

Not applicable.

Date:
13.04.2025

Signature of course coordinator

Assoc.prof.phd. Mihai SUCIU

Signature of seminar coordinator

Assoc.prof.phd. Mihai SUCIU

Date of approval:

Signature of the head of department

Assoc.prof.phd. Adrian STERCA

[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.*".