COURSE DESCRIPTION CARD - SYLLABUS

Course name
Optimization fundamentals [S2TIIZM1E>PO]

Course

Field of study
Information Technology for Smart and Sustainable Mobility

Year/Semester
1/1

Area of study (specialization)
–

Profile of study
general academic

Level of study
second-cycle

Course offered in
English

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
32

Laboratory classes
16

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

4,00

Coordinators

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Lecturers

Prerequisites

Knowledge: Basic Mathematics - including algebra, functions, and elementary calculus (especially derivatives and optimization of functions). Linear Algebra - understanding of vectors, matrices, and systems of linear equations. Fundamentals of Operations Research - general awareness of what optimization is and why it is used. Skills: Analytical Thinking and Problem Solving - ability to approach complex problems methodically and break them down into smaller parts.

Course objective

To provide the fundamental concepts and tools related to operational research which will be applied to different transport domains.To model transportation systems and specifying both the cost function and variables looking for optimal solutions taking in consideration the ecosystem constraints.

Course-related learning outcomes

Knowledge:
The student has advanced and in-depth knowledge of optimization methods in transport, including theoretical foundations, tools, and means used to solve optimization problems, in particular knows

optimization models, linear programming, the simplex algorithm, integer programming, dynamic programming, and heuristic methods.
The student has advanced detailed knowledge of selected issues related to the application of optimization methods to solving transport tasks.

Skills:
The student is able to use optimization methods to solve optimization problems in transport
The student is able to plan and conduct computer simulations, interpret the obtained results, draw conclusions, and formulate and verify hypotheses related to complex engineering problems and simple research problems in the field of transport.
The student is able to solve an optimization task in transport according to a given specification, using appropriate methods, techniques, and tools.

Social competences:
The student understands the importance of using the latest knowledge in transport engineering to solve research and practical problems

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Written exam
Practical work - solving transport problems

Programme content

Optimization models, Linear programming, Simplex algorithm, Integer programming, Dynamic programming, Heuristic methods

Course topics

Optimization models: Objective function, variables and constraints.
The linear programming model: Convex sets and linear programming algorithms.
The simplex algorithm. Duality / Sensitivity Analysis
Convex functions.
Optimality criteria: Kuhn-Tucker conditions.
Quadratic programming.
Geometric programming.
Integer programming and algorithms.
Dynamic programming.
The transport problem (model).
Heuristic optimization techniques.

Teaching methods

The course is conducted remotely (online) in a synchronous format. Classes may also be held in person. Multimodal presentation. Practical examples, case study.

Bibliography

Basic:
Hillier F., Lieberman G. (2002), Introduction to Operations Research. McGraw Hill Publishing, New York
Bazaraa, M., Jarvis, J., Sherali, H. (2010), Linear Programming and Network Flows, John Wiley &Sons.
Bazaraa, M., Sherali, H., Shetty, C. (2006), Nonlinear Programming and Network Flows, John Wiley &Sons.

Additional:
Wolsey L. A., & Nemhauser G. L. (1999), Integer and combinatorial optimization (Vol. 55). John Wiley & Sons

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	48	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	52	2,00