COURSE DESCRIPTION CARD - SYLLABUS

Course name
Optimization methods in transport and logistics 1 [S1Trans1>MOwL1]

Course

Field of study
Transport

Year/Semester
3/6

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
elective

Number of hours

Lecture
15

Laboratory classes
15

Other (e.g. online)
0

Tutorials
0

Projects/seminars
0

Number of credit points

1,00

Coordinators

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Lecturers

Prerequisites

KNOWLEDGE: the student has a structured, theoretically founded knowledge of technology, transport systems and various means of transport. SKILLS: the student is able to properly use information and communication techniques, applicable at various stages of the implementation of transport projects. SOCIAL COMPETENCIES: the student understands that in technology, knowledge and skills very quickly become obsolete.

Course objective

Learning the techniques of making managerial decisions in the field of transport and logistics in the selection and effective use of technical and human resources.

Course-related learning outcomes

Knowledge:
The student has knowledge of important directions of development and the most important technical achievements and other related scientific disciplines, in particular transport engineering.
The student knows the basic techniques, methods and tools used in the process of solving tasks in the field of transport, mainly those of an engineering nature.

The student has a basic knowledge of managing / running a business and an individual entrepreneurship.

Skills:
The student is able - when formulating and solving transportation tasks - use appropriately selected methods, including analytical, simulation or experimental methods.
The student is able to assess the computational complexity of algorithms and transport problems.
The student has the ability to formulate tasks in the field of transport engineering and their implementation using at least one of the popular tools.

Social competences:
The student is able to think and act in an entrepreneurial way, e.g. finding commercial applications for the created system, taking into account not only the business benefits, but also the social benefits of the conducted activity.
The student is aware of the importance of knowledge in solving engineering problems, knows examples and understands the causes of malfunctioning transport systems that have led to serious financial and social losses or to serious loss of health and even life.
The student correctly identifies and resolves the dilemmas related to the profession of a transport engineer.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
In the lecture part: the workshop based on a team solution to a given decision problem. Written test summarizing the lectures, in the form of a multiple-choice test. In the laboratory part: activity during classes and ongoing preparation for classes. Implementation of laboratory tasks individually and in groups. Periodic written checking of preparation for classes.

Programme content

The module is composed of the following items:
1. Quantitative approach for decision problem solving.
2. Model design with mathematical programming.
3. Solving problem with numerical techniques - solvers.
4. Linear programming.
5. Integer programming.
6. Binary programming.

Course topics

Lecture and laboratory classes are closely related. On the basis of the content presented during the lectures, the tasks (in most cases problematic, based on case studies) are performed during the laboratory classes.
1. Introduction (M0).
Key concepts related to the decision-making process and building a mathematical model; presentation of the main thematic areas and discussion of the detailed program, i.e .: module 0 (M0): introduction, module 1 (M1): selection and use of resources. Formulating an exemplary decision problem in which an intuitive solution is sought, and the effectiveness of the solution is checked in the form of a mathematical model (formal record of the decision problem) and solved with the use of an optimisation engine (Solver Platform for MS Excel).
2. The portfolio problem; application of a linear programming (M1).
The principle of building a product portfolio, thanks to the linear programming technique. Portfolio problem model formulated as a linear programming problem and solved with the use of two alternative techniques: the graphical method and the simplex method in the form of the Solver available in MS Excel (Office).
Sensitivity analysis of the problem using the generated reports: results, sensitivity analysis and constraints (Solver option).
3. The fleet composition problem; application of an integer programming (M1).
The rules for determining the types and numbers of the fleet in a transport company - the fleet composition problem based on a defined set of transport tasks. The model of the fleet composition problem is

formulated as an integer programming and solved using the branch & bound technique (available in Solver for MS Excel). Analysis and interpretation of the solution.
4. The knapsack problem; application of a binary and integer programming (M1).
A formulation of the problem of loading / packing products into collective packaging, expressed in the form of a classic knapsack problem. Construction of a mathematical model with the use of a binary and an integer programming, depending on the complexity of the problem and the specificity of the loading.
5. Knowldege summary.
Final test.

Teaching methods

1. Problem lecture with a multimedia presentation.
2. Workshop methods.
3. Case study.
4. Laboratories - computational experiments.

Bibliography

Basic
1. Ignasiak E. (red.): Badania operacyjne. PWE, Warszawa, 2001 (in Polish).
2. Sawicki P.: Optymalizacja w transporcie. Politechnika Poznańska, Wydział Inżynierii Lądowej i Transportu, Poznań 2009. E-skrypt dostępny pod adresem: http://piotr.sawicki.pracownik.put.poznan.pl/dydaktyka/_-metody-optymalizacji-w/
Additional
1. Christopher M.: Logistyka i zarządzanie łańcuchem dostaw. Polskie Centrum Doradztwa Logistycznego, Warszawa, 2000 (in Polish).
2. Harmon M.: Step-by-Step Optimization with Excel Solver, www.ExcelMasterSeries.com, 2011.
3. Kukuła K. (red.): Badania operacyjne w przykładach i zadaniach, Wydawnictwo Naukowe PWN, Warszawa, 2011 (in Polish).
4. Sawicki P.: Wielokryterialna optymalizacja procesów w transporcie, Wydawnictwo Instytutu Technologii Eksploatacji, Radom, 2013 (in Polish).
5. Szapiro T. (red.): Decyzje menedżerskie z Excelem, PWE, Warszawa, 2000 (in Polish).

Breakdown of average student's workload

	Hours	ECTS
Total workload	35	1,00
Classes requiring direct contact with the teacher	30	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	5	0,00