COURSE DESCRIPTION CARD - SYLLABUS

Course name

Optimization of resources in road transport

Course

Field of study	Year/Semester
Transport	4/7
Area of study (specialization)	Profile of study
	general academic
Level of study	Course offered in
First-cycle studies	Polish
Form of study	Requirements
part-time	elective

Number of hours

Lecture	Laboratory classes	Other (e.g. online)
18	9	0
Tutorials	Projects/seminars	
0	0	

Number of credit points

4

Lecturers

Responsible for the course/lecturer:

Piotr Sawicki, PhD (Hab.)

email: piotr.sawicki@put.poznan.pl

ph. 61 6652249

Faculty of Civil and Transport Engineering

3 Piotrowo street, 60-965 Poznan

Responsible for the course/lecturer:

Hanna Sawicka, PhD (Eng.)

email: hanna.sawicka@put.poznan.pl

ph. 61 6652249

Faculty of Civil and Transport Engineering

3 Piotrowo street, 60-965 Poznan

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, as well as with regard to distributed resources management (supply chains).

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:

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

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, module 2 (M2): building supply chains. 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 optimization engine (Solver Platform for MS Excel).

2. The portfolio problem; application of a linear programming (M1).

Principles of building a product portfolio using the linear programming technique: problem identification, construction of a mathematical model, solving with the use of two alternative techniques (graphic method and simplex method), problem sensitivity analysis using 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. Problem solving using Solver for MS Excel; analysis of the obtained solution.

5. The scheduling problem (a developed resource allocation problem); application of a binary programming (M1).

Formulating the resource allocation problem as a simplification of the scheduling problem. Analysis of the problem of assigning employees to tasks within the defined time frame of task execution. Building a mathematical model in the form of a binary programming task and solving the problem using Solver for MS Excel.

6. Workshop on the selection and use of resources (M1).

Summary of M1 in the form of an analysis of the presented decision problem (work in groups to solve various problems; search for alternative solutions). Construction of a mathematical model, selection of a method and problem solution, solution interpretation and sensitivity analysis.

7. An introduction to supply chain design (M2)

The key requirements for building optimal transport and storage solutions are analyzed. Classification of models describing the functioning of nPo-pPr-Ki supply chains in the following dimensions: the number of nPo cells (1- and multi-level models), the number of products whose flow is analyzed pPr (1- and multi-product models) and Ki optimization criteria (models based on functions: transport costs KT, storage costs KM and production costs KP).

8. The supply chain design; 1Po-1Pr-KT model (M2).

Modeling, optimization and practical application of the 1-tier (n = 1), 1-product (p = 1) supply chain, based on the transport cost (KT) function. The essence and solving a balanced and unbalanced problem. Application of Solver for MS Excel.

9. The supply chain design; 1Po-1Pr-KT+KM (M2).

Modeling, optimization and practical application of a 1-tier (n = 1), 1-product (p = 1) supply chain, based on the function of transport cost and storage cost (KT + KM). Application of Solver for MS Excel. Comparison of the application area of the 1Po-1Pr-KT and 1Po-1Pr-KT + KM models

10. The supply chain design; 2Po-1Pr-KT+KM (M2).

Modeling, optimization and practical application of a 2-tier (n = 2), 1-product (p = 1) supply chain, based on the function of transport cost and storage cost (KT + KM). Application of Solver for MS Excel.

11. The supply chain design; 2Po-2Pr-KT+KM (M2).

Modeling, optimization and practical application of a 2-tier (n = 2), 2-product (p = 2) supply chain, based on the function of transport cost and storage cost (KT + KM). Application of Solver for MS Excel.

12. Knowldege summary (M1 and M2).

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	90	4,0
Classes requiring direct contact with the teacher	27	1,0
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) [1]	63	3,0

[1] delete or add other activities as appropriate