COURSE DESCRIPTION CARD - SYLLABUS

Course name
Management of transport systems [S1Trans1>ZST]

Course

Field of study
Transport

Year/Semester
3/5

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

2,00

Coordinators

dr hab. inż. Piotr Sawicki prof. PP
piotr.sawicki@put.poznan.pl

Lecturers

Prerequisites

Basic knowledge of techniques, methods and tools used in the process of managing transport systems.

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 development trends and the most important technical achievements and of 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 of an engineering nature engineering.
The student has basic knowledge of managing and running a business and knows the general principles of creating and developing forms of individual entrepreneurship.

Skills:
Student is able, when formulating and solving tasks in the field of transport, to apply 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 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 can think and act in an entrepreneurial way, incl. finding commercial applications for the created system, taking into account not only business benefits, but also social benefits of the conducted activity.
The student correctly identifies and solves 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 summarising 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. Decision making process - quantitative approach.
2. Design of mathematical model for a decision problem and problem solving with the numerical techniques, i.e. solvers.
3. Linear programming for portfolio analysis.
4. Integer programming for fleet composition and bin packing problems.
5. Binary programming for crew scheduling.
6. Model for transport planning at 1-tier supply chain: 1Po-1Pr-KT.
7. Model for facility and transport planning at 1-tier supply chain: 1Po-1Pr-KT+KM.

Course topics

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 mathematical modelling (formal description of the decision problem) and solving with the use of an optimisation engine (Solver Platform for MS Excel).
2. The portfolio problem with the application of a linear programming (M1).
Principles of product portfolio in transport sector. Portfolio problem 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 as an add-in of MS Excel (Office). Sensitivity analysis of the problem solving using the generated reports: results, sensitivity analysis and constraints (Solver option).
3. The fleet composition problem with 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 formulated as an integer programming and solved using the branch & bound technique in Solver for MS Excel. Analysis and interpretation of the solution.
4. The knapsack problem with application of a binary and integer programming (M1).
A formulation of the problem of loading / packing products into bin/container, expressed as a classic knapsack problem. Construction of a mathematical model with the use of a binary and an integer

programming, depending on the complexity and specificity of the loading.
5. The scheduling problem (a developed resource allocation problem); application of a binary programming (M1).
Formulating the resource allocation problem as a scheduling problem. Analysis of the problem of assigning employees to tasks within the defined time frame. Building a mathematical model in the form of a binary programming task and solving the problem using Solver for MS Excel.
6. The supply chain design with 1Po-1Pr-KT model (M2).
Modeling, optimisation 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.
7. The supply chain design with 1Po-1Pr-KT+KM model (M2).
Modeling, optimisation and practical application of the 1-tier (n = 1), 1-product (p = 1) supply chain, based on the fixed and variable warehousing cost (KM) and transport cost (KT) functions. Solving an exemplary problem with application of Solver for MS Excel.

Teaching methods

1. Methodological and problem-based lecture.
2. Workshop methods.
3. Case study.
4. 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/
Suplementary
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	55	2,00
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)	25	1,00