COURSE DESCRIPTION CARD - SYLLABUS

Course name
Analysis and Design of Transportation Networks

Course

Field of study
Logistics
Year/Semester
1/2
Area of study (specialization)
Logistics systems
Profile of study
general academic
Level of study
Second-cycle studies
Course offered in
English
Form of study
full-time
Requirements
elective

Number of hours

Lecture
30
Laboratory classes
Other (e.g. online)
Tutorials
Projects/seminars
30

Number of credit points

4

Lecturers

Responsible for the course/lecturer:
Ph.D., D.Sc., Eng. Jacek Żak, University Professor

Mail to: jacek.zak@put.poznan.pl

Faculty of Engineering Management

ul. J. Rychlewskiego 2, 60-965 Poznań

Responsible for the course/lecturer:

Prerequisites

Student has a basic background in transportation, logistics and management. He can carry out analytical tasks and apply basic management tools and methods in transportation and logistics. He is able to perform a team work.

Course objective

To familiarize students with the basic concepts and terms associated with transportation and transportation systems. Present operating rules of Transportation Systems and data describing their operations.

Course-related learning outcomes

Knowledge

1. Student knows dependencies in the area of analysis and design of transportation networks [P7S_WG_01]

2. Student knows issues of process mapping, process orientation within analysis and design of transportation networks [P7S_WG_03]

3. Student knows extended concepts for analysis and design of transportation networks [P7S_WG_05]

4. Student knows the detailed methods, tools and techniques characteristic of analysis and design of transportation networks [P7S_WK_01]

Skills

1. Based on the literature review and analysis of other sources of information, student can collect and provide, in an orderly manner, information on the problem within analysis and design of transportation networks [P7S_UW_01]

2. Student can design, using appropriate methods and techniques, the transportation network and the process associated with it including defining the path of its implementation and potential threats or limitations in analyzed domain [P7S_UW_05]

3. Student is able to design, using properly selected means, an experiment, analytical process or scientific research project/ program solving a problem within analysis and design of transportation networks [P7S_UK_01]

4. Student can identify changes in requirements, standards, regulations, technological development and behaviour of the labor market. Based on their recognition he/she is able to determine the needs to extend and enhance his/ her own and others' knowledge within analysis and design of transportation networks [P7S_UU_01]

Social competences

1. Student can recognize causal relationships in achieving the set goals and grading the significance of alternative or competitive tasks within analysis and design of transportation networks [P7S_KK_01]

2. Student is aware of his/her responsibility and initiation of activities related to the formulation and information sharing and cooperation in the society in the scope of analysis and design of transportation networks [P7S_KO_02]

3. Student is responsible for his/ her own work and ready to comply with the rules of working in a team and taking responsibility for the tasks carried out jointly within analysis and design of transportation networks [P7S_KR_01]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture: Formative assessment: homeworks, discussions summarizing individual lectures, giving the student the opportunity to assess the understanding of the problem, active participation in lectures. Final assessment: 45 minute, written exam in the subject , test composed of 25 questions (closed and open); satisfactory threshold - 50%.

Project: Formative assessment: assessment of class activities, active participation in classes. Final assessment: grading the project in the field of a transportation network design/ development,

evaluation of the student's skills in mathematical modeling and application of selected network algorithms. Testing students' ability to perform computational experiments.

Programme content

Lecture: Introduction to the topic. The definition of transportation, transportation systems and transportation networks. Basic characteristics and operating rules of transportation networks. Content of the c ourse/ lecture. Classification of transportation networks within tranasportation systems. Single-mode and multimodal transportation networks. Passengers' vs. freight transportation networks. Major components of transportation systems and their description. Transportation infrastructure as a skeleton of Transportation Systems. Network orientation of the transportation infrastructure. Presentation of different infrastructural solutions in Transportation Systems. Linear and Point infrastructure. Analysis of road-, railway-, sea- and air- transportation infrastructure. Comparative characteristics of transportation networks. Analysis of statistical data. Review of road, railway-, sea- and air-transportation networks. Selected examples of transportation networks around the World. Intuitive/ heuristic oriented design of a transportation network supported by simulation. Development of different, alternative structures of a transportation network and their multiple criteria evaluation. Analysis of road/ railway networks in different countries. The principles of a 4-stage model. Network design in a 4-stage model. Interactions between analysis of transportation demand, design of a transportation network, traffic assignment, definition of transportation modes (types of vehicles), allocation of crews. Desription of the available tools and methods (e.g. Visum, Vissim Traffic Simulation Software). Development of the optimal structure of a transportation network. Presentation of selected algorithms for network design, including: maximum flow algorithm, shortest path algorithm and transportation method. Quantitatively oriented design of transportation networks. Solving a location problem in a transportation network. Definition of the optimal locations of the point/ node infrastructure in the transportation network. Finding the locations of airports, distribution/ logistics centers, transportation hubs, etc. Single- and multiple criteria formulation of the location problems. The princiles of the transportation network redesign. Development of a new network structure and original transportation solutions. Implementation of solutions and testing the developed network.

Project: Introduction to the project. Characteristics and major rules of the project preparation. Description of the basic rules of a transportation network design and redesign. Selection of transportation networks to be designed/ redesigned and evaluated within the projects. Analysis of selecetd components of a transportation network - passenger or freight; unimodal and multimodal. Application of a 4-stage model to design/ redesign of a transportation network. Redesign of a transportation network based on the redefined transportation demand - definition of the O-D matrix. The stage of the design of a transportation network combined with traffic assignment to the network and definition of transportation modes (types of vehicles) and allocation of crews. Performing a variant-/ scenario oriented simulations of a transportation network operations. Analysis of selected transportation solutions. Application of network algorithms, including: maximum flow algorithm, transportation method, location algorithms, etc. Evaluation of considered solutions. Definition of evaluation parameters/ criteria. Modeling of the DM's preferences. Computational experiments -

multiple criteria ranking of solutions. Selection of the compromise solution. Design of an optimal transportation network.

Teaching methods

Lecture: conversatory lecture; interactive speech; case studies; problem oriented discussion.

Project: project method; practical analysis of the network design/redesign problem; cmputational experiments.

Bibliography

Basic

1. Nagurney A., Sustainable Transportation Networks, Edward Elgar Publishing, London - New York, 2000.

2. Wojewódzka-Król K., Rolbiecki R., Infrastruktura transportu, Wydawnictwo Naukowe PWN, Warszawa 2018.

3. Bierlaire M. (Eds.), Integrated Transport and Land Use Modeling for Sustainable Cities, Routledge, New York, 2014.

4. Daganzo C., Fundamentals of Transportation and Traffic Operations, Pergamon Press, New York, 1997.

Additional

1. Latora V., Nicosia V., Russo G., Complex Networks: Principles, Methods and Applications, Cambridge University Press, Camridge - London, 2019.

2. Tumlin J., Sustainable Transportation Planning. Tools for Creating Vibrant, Healthy, and Resilient Communities, Wiley, San Francisco - Toronto, 2012.

3. Żak J., Hadas Y., Rossi R.(Eds.), Advanced Concepts, Methodologies and Technologies for Transportation and Logistics, Springer, Heidelberg, 2018.

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,0
Classes requiring direct contact with the teacher	60	2,5
Student's own work (literature studies, preparation for classes, preparation for tests, project preparation) [1]	40	1,5

[1] delete or add other activities as appropriate