GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

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| Subject name and code | MODELLING OF TRANSPORT PROCESSES, PG_00045922 | | |
| Field of study | Transport | | |
| Date of commencement of studies | February 2024 | Academic year of realisation of subject | 2023/2024 |
| Education level | second-cycle studies | Subject group | Obligatory subject group in the field of study<br>Subject group related to scientific research in the field of study |
| Mode of study | Full-time studies | Mode of delivery | at the university |
| Year of study | 1 | Language of instruction | Polish |
| Semester of study | 1 | ECTS credits | 4.0 |
| Learning profile | general academic profile | Assessment form | exam |
| Conducting unit | Department of Transportation Engineering -> Faculty of Civil and Environmental Engineering | | |
| Name and surname of lecturer (lecturers) | Subject supervisor | dr hab. inż. Jacek Oskarbski | |
| | Teachers | dr hab. inż. Jacek Oskarbski<br>mgr inż. Konrad Biszko | |

| Lesson types and methods of instruction | | | | | | | |
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| | Lesson type | Lecture | Tutorial | Laboratory | Project | Seminar | SUM |
| | Number of study hours | 15.0 | 0.0 | 30.0 | 0.0 | 0.0 | 45 |
| | E-learning hours included: 0.0 | | | | | | |

| Learning activity and number of study hours | | | | | |
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| | Learning activity | Participation in didactic classes included in study plan | Participation in consultation hours | Self-study | SUM |
| | Number of study hours | 45 | 10.0 | 45.0 | 100 |

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| Subject objectives | Solving transport issues with the use of methods of graph theory, queuing theory, computer simulations, mobile automats. Modelling and dependencies on the traffic flow of vehicles. Basic characteristics of random distributions of variables used in the description of the traffic process. Functions of probability density used to describe the distribution of selected parameters in the vehicle stream (free and nonfree traffic). Traffic as a stochastic process, non-stationary. |

| Learning outcomes | Course outcome | Subject outcome | Method of verification |
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| | [K7_U03] formulates research problems and selects appropriate analytical methods for their effective solution, using advanced IT tools, and critically evaluates the obtained results | The use of graph theory for modelling transport networks The use of freight task-sharing models and traffic distribution models in a transport network. Selection of tools for transport system analysis and evaluation depending on the type of model used.<br>Selection of tools for transport system analysis and evaluation depending on the type of model used. | [SU3] Assessment of ability to use knowledge gained from the subject<br>[SU4] Assessment of ability to use methods and tools |
| | [K7_K01] recognizes the importance of knowledge related to the field of study in solving cognitive and practical problems | Student can apply elements of statistical analysis and micro, macro and mesoscopic modelling in solving cognitive and practical problems related to transport systems. | [SK2] Assessment of progress of work<br>[SK3] Assessment of ability to organize work<br>[SK4] Assessment of communication skills, including language correctness<br>[SK5] Assessment of ability to solve problems that arise in practice |
| | [K7_W01] identifies in an in-depth way phenomena related to the field of study as well as theories describing them and possible methods of analyzing processes occurring in the life cycle of technical systems | Solve issues related to modelling of transport processes using methods of systems of mass handling and elements of traffic theory applied to modelling transport systems. | [SW1] Assessment of factual knowledge<br>[SW2] Assessment of knowledge contained in presentation |
| | [K7_W06] identifies reliable sources of information relevant to the analyzed issues | Selection of sources and type of data for transport system analysis and evaluation depending on the model used. | [SW1] Assessment of factual knowledge<br>[SW2] Assessment of knowledge contained in presentation |

**Subject contents**

Transport system models. Arrangement of streams in transport networks. Surrounding the transport system.Forecasting the development of transport systems. Dynamics of transport processes. Definitions: mass handling system, railway network, transport network, transport process. Graphical representation of the transport network. Classification of mass handling systems. Operating disciplines. Division of railway systems.Non-branded handling systems. Transport process models - elements of the model, structure, traffic flows.Simulation models.Modelling and dependencies on the traffic flow of vehicles. Basic characteristics of random distributions of variables used in the description of the traffic process.Functions of probability density used to describe the distribution of selected parameters in the vehicle stream (free and nonfree traffic). Traffic as a stochastic, non-stationary process.Macroscopic and mesoscopic motion models - hydrodynamic analogy, wave model of motion, diffusion models (Pacey, Payne, Robertson, model with rectangular distribution of vehicle driving time), LWR model, Daganzo cellular model, cellular machines, event-based models. Microscopic models - driving models behind the leader (e.g. classic, stimulus response, psycho-spacing, fuzzy logic, psycho-phisical, Pipes linear, Bando, Gipps, SmartPath Simulation), lane change models, models of joining the traffic. Models of travel formation. Spatial distribution models. Models of division of transport tasks. Models of traffic distribution in the transport network. Packets of programs for modelling traffic in macro, meso and microscopic view.

**Prerequisites and co-requisites**

Knowledge of subjects transport systems, Traffic engineering

**Assessment methods and criteria**

| Subject passing criteria | Passing threshold | Percentage of the final grade |
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| written exam | 60.0% | 60.0% |
| tutorials | 90.0% | 40.0% |

**Recommended reading**

Basic literature

1. Gniadenko B. W., Kowalenko I. N.: Wstęp do teorii obsługi masowej. PWN, Warszawa 1971.2. Koźniewska I., Włodarczyk M.: Modele odnowy, niezawodności i masowej obsługi. PWN, Warszawa 1978.3. Leszczyński J. Modelowanie systemów i procesów transportowych, Oficyna wydawnicza Politechniki Warszawskiej, 1999.4.Sienkiewicz P.: Inżynieria systemów. MON, Warszawa 1983.5. Smalko Z.: Modelowanie eksploatacyjnych systemów transportowych. ITE, Radom 1996.6. Woropay M., Knopik L., Landowski B.: Modelowanie procesów eksploatacji w systemie transportowym. Biblioteka Problemów Eksploatacji. ITE, Bydgoszcz-Radom 2001.

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| | Supplementary literature | Jacyna M.: Modele wielokryterialne w zastosowaniu do oceny systemów transportowych.Wyd.Pol.Warszawskiej,Warszawa 2002. |
| | eResources addresses | Adresy na platformie eNauczanie: |
| Example issues/ example questions/ tasks being completed | General methodology of model construction. The concept of the model, model properties and model classification. Aim and scope of modeling of transport and logistics systems and processes. Basic concepts, purpose of modeling, classification of tasks, construction of the model.Stages of model construction.Modelling of traffic flows.Modeling of movement in networks.Graphic representation of the system and transport process. Graphic representation of the transport network. Models of the transport system environment - the demand for transport and its division. Stochastic character of transport processes.Methods of mass service theory in modelling of transport processes. Classification of mass handling systems. Disciplines of service. Division of railway systems. Methods and models of railway systems.Traffic flow and characteristics related to it. General assumptions. Traffic flow on the road. Traffic flow in the transport network. Conditions imposed on the traffic flow moved along elements of the structure of the transport network.Models of distribution of streams in the transport network - transport costs, traffic congestion, distribution of streams of minimal cost and distribution of equilibrium, linear and non-linear model.Models of a transport system with the use of methods of cellular automats - elements of the model, structure, neighbours, traffic rules, examples of applications.Transport process models - process dynamics, process phase network structure, process implementation trajectories, simulation of transport processes, monte carlo method. Markov models of transport processes with the use of methods of the theory of queues. Birth and death process. Non-branded models of transport processes with the use of methods of the theory of queues, simulation methods. The issue of congestion - loss of notification. | |
| Work placement | Not applicable | |

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