



## COURSE DESCRIPTION CARD - SYLLABUS

Course name

Traffic Modelling and Simulation - Pt. 1

### Course

Field of study

Year/Semester

Transport

3/6

Area of study (specialization)

Profile of study

Road transport

general academic

Level of study

Course offered in

First-cycle studies

Polish

Form of study

Requirements

full-time

elective

### Number of hours

Lecture

Laboratory classes

Other (e.g. online)

15

15

0

Tutorials

Projects/seminars

0

0

### Number of credit points

1

### Lecturers

Responsible for the course/lecturer:

Responsible for the course/lecturer:

Marek Maciejewski

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Faculty of Civil and Transport Engineering

### Prerequisites

Basic concepts of traffic engineering and rules of road traffic organization. Basic knowledge of modeling methods and computer simulations. The ability to approximate and discretize continuous problems. Numerical methods in the field of linear algebra and computer graphics. Basics of operating typical computer systems. Determining the hierarchy and schedule of tasks in formulating mathematical and numerical problems. Independence. Responsibility.

### Course objective

Providing information on traffic modeling and simulation. Principles of developing macroscopic and microscopic traffic models. Classification and descriptions of macroscopic models. Classification and descriptions of microscopic models. Transformation of traffic descriptions from a continuous level to a discrete level. Development of traffic simulators using numerical methods.

### Course-related learning outcomes

Knowledge



The student has an ordered, theoretically founded general knowledge of technology, transport systems and various means of transport

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 knowledge of ethical codes regarding transport engineering, is aware of the dangers related to environmental protection and understands the specificity of mission-critical systems

#### Skills

The student is able to obtain information from various sources, including literature and databases (both in Polish and in English), integrate it properly, interpret it and critically evaluate it, draw conclusions, and comprehensively justify his/her opinion.

The student can properly use information and communication techniques, applicable at various stages of the implementation of transport projects

The student is able to properly plan and conduct perform experiments, including measurements and computer simulations, interpret the obtained results, and correctly draw conclusions

The 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 - in accordance with the given specification - to design (create a model of a fragment of reality), formulate a functional specification in the form of use cases, formulate non-functional requirements for selected quality characteristics) and implement a device or a widely understood system in the field of means of transport, using appropriate methods, techniques and 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

#### Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lectures: written test on the lecture material. Laboratory classes: individual reports on the conducted traffic simulations.

#### Programme content

Modeling and simulation. Basic parameters of the movement and relations between them. Movement measurements as the basis of mathematical description. Fundamental diagram. Classification of traffic models.

Macroscopic models: description and dependencies. LWR models for one variable (rate or density) and different static relationships. 2-equation models with the terms of convection, anticipation and relaxation. Review of 2-equation models and their classification. Symmetric (isotropic) and asymmetric



(anisotropic) models. Conditioning of motion models: spectral radius and conditioning index. Transformation of traffic models from continuous to discrete level. Discretization and approximation. Numerical methods of solving discretized motion models. Evaluation of traffic models.

Microscopic models: description and dependencies. Classification and discussion of microscopic models. Model limitations. Traffic simulators review. Rules for selecting a traffic simulator. Hybrid simulators and their types. Review of hybrid simulators.

### Teaching methods

1. Lecture: multimedia presentation. 2. Laboratory classes: conducting computer simulations of road traffic and development of simulation results.

### Bibliography

#### Basic

1. Treiber M., Kesting A., Traffic flow dynamics. Data, models and simulation, Springer-Verlag, Berlin Heidelberg 2013
2. Daamen W., Buisson Ch., Hoogendoorn S.P., Traffic simulation and data. Validation methods and applications, CRC Press, Boca Raton 2014
3. Traffic flow theory, A state-of-the-art report (ed. Gartner R., Messer C.J., Rathi A.K.), TRB 1995
4. Barceló J., Fundamentals of traffic simulation, International Series in Operations Research & Management Science, vol. 145, Springer 2010

#### Additional

1. Adamski A., Inteligentne systemy transportowe: sterowanie, nadzór i zarządzanie, Kraków, UWN 2003

### Breakdown of average student's workload

	Hours	ECTS
Total workload	40	1,0
Classes requiring direct contact with the teacher	30	0,7
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) <sup>1</sup>	10	0,3

<sup>1</sup> delete or add other activities as appropriate