STUDY MODULE DESCRIPTION FORM

Name of the module/subject		Code
Traffic Modelling and Simulation		**1010611361010615997**
Field of study: **Transport**	Profile of study (general academic, practical): **general academic**	Year /Semester: **3 / 6**
Elective path/specialty: **Road Transport**	Subject offered in: **Polish**	Course (compulsory, elective): **obligatory**
Cycle of study: **First-cycle studies**	Form of study (full-time,part-time): **full-time**	
No. of hours: Lecture: **1** Classes: **-** Laboratory: **1** Project/seminars: **-**		No. of credits: **1**
Status of the course in the study program (Basic, major, other): **other**	(university-wide, from another field): **university-wide**	
Education areas and fields of science and art: **technical sciences** **Technical sciences**		ECTS distribution (number and %): **1 100%** **1 100%**

Responsible for subject / lecturer:

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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Fundamental concepts from the scope of traffic engineering and rules for organization of road traffic. Basic knowledge about modelling and computer simulation.
2	**Skills**	Skills related to approximation and discretization of continuous problems. Numerical methods from the scope of linear algebra and computer graphics. Basics of information technology for typical computer systems.
3	**Social competencies**	Definition of hierarchy and timetables of particular tasks to formulate mathematical and numerical problems. Independence. Responsibility.

Assumptions and objectives of the course:

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

Study outcomes and reference to the educational results for a field of study

Knowledge:

1. Knows universal principles of modelling and simulation of deterministic problems - [K1A_W06]
2. Exhaustively knows classification and description of macroscopic road traffic models - [K1A_W05]
3. Knows selected macroscopic models and their computer implementation - [K1A_W06]
4. Exhaustively knows classification and description of microscopic road traffic models - [K1A_W05]
5. Knows selected microscopic models and has practice in their computer simulations - [K1A_W06]
6. Knows methods of traffic lights steering and the light-signalling devices - [K1A_W05]

Skills:

1. Is able to create road network models for computer simulation - [K1A_U18]
2. Is able to put traffic light programmes into road network models - [K1A_U18]
3. Is able to define initial and boundary conditions for numerical traffic simulations - [K1A_U07]
4. Is able to use selected systems for road traffic simulation - [K1A_U18]
5. Is able to carry out a simulation of traffic lights and its optimization - [K1A_U07]

Social competencies:

1. Is able independently carry out simulations on the basis of external data - [K1A_K06]
2. Is able to define priorities for traffic flow optimization - [K1A_K05]
3. Understands the need for cooperation in preparation and runing a simulation - [K1A_K04]
4. Understands the need for applying safety- and environmentally-friendly solutions - [K1A_K07]

Assessment methods of study outcomes

Lectures: credit on the grounds of written tests

Exercise: individual reports from performed road traffic simulations

Course description

Modeling and simulation. Basic traffic parameters and relationships between them. Motion measurements as the basis for mathematical description. Fundamental diagram. Classification of traffic models.

Macroscopic models: description and relationships. The LWR models for one variable (speed or density) and various static relationships. 2-equation models with convection, anticipation and relaxation elements. Review of 2-equation models and their classification. Symmetrical (isotropic) and asymmetric (anisotropic) models. Conditioning of motion models: spectral radius and spectral condition number. Transformation of traffic models from continuous to discrete level. Discretization and approximation. Numerical methods of solving discretised traffic models. Evaluation of traffic models.

Microscopic models: description and relationships. Classification and discussion of microscopic models. Model restrictions. Review of traffic simulators. Rules for choosing a traffic simulator. Hybrid simulators and their types. Overview of hybrid simulators.

Basic bibliography:

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 bibliography:

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

Result of average student's workload

Activity	Time (working hours)
1. Preparation for classes	7
2. Participation in classes (according to plan)	30
3. Consolidation of the content of classes / report	10
4. Consultations	2
5. Preparation for the exam / pass	10
6. Participation in the exam / pass	1

Student's workload

Source of workload	hours	ECTS
Total workload	60	1
Contact hours	33	1
Practical activities	16	1