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Master in SMArt transport and LOGistics for cities / SMALOG

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Master Curricula

development and implementation

at National Transport University - NTU

Project Acronym: SMALOG

Duration: 15/10/2017 - 14/10/2020 (extension to 14/10/2021)

Project Coordinator: University of Rome Tor Vergata (Italy)

Proposal full title: Master in Smart transport and logistics for cities

Project number: 585832-EPP-1-2017-1-IT-EPPKA2-CBHE-JP

Document Title: Master Curricula

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Summary: Deliverable series "Master Curricula" presents the curricula process of the 2nd level Master developed for the Ukraine and Georgian Universities according to the Bologna process standards within the SmaLog project. This deliverable reports curricula developed and implemented at National Transport University - NTU. After a short introduction, the deliverable describes the local conditions and needs and the results of the international reviews on which the curricula have been built. The deliverable provides the structure in terms of modules, the expected learning outcomes, the reference publications and materials needed to deliver the Master.

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1 Introduction

Within the framework of the Erasmus+ - Capacity Building in the Higher Education programme the Master in smart transport and logistics for cities project (SmaLog in the following) has been selected for funding. The project started in October 2017 and will end in October 2020.

The consortium is composed of four EU universities, four Ukraine and two Georgian universities, and one institute of advanced studies, namely the Department of Enterprise Engineering "Mario Lucertini" of the University of Rome Tor Vergata (the project coordinator), the Research Centre on Transport and Logistics of "Sapienza" University of Rome, Department of Transport Systems and Logistics of the O. M. Beketov National University of Urban Economy in Kharkiv, Department of Transport Technologies of the Lviv Polytechnic National University, Department of Automobiles and Transport Technologies of the Zhytomyr State Technological University, Department of Transport Systems and Road Safety of the National Transport University, Department of Logistics of the Georgian Technical University, Business and Management Faculty of the Batumi State Maritime Academy, Faculty of Transport of the Silesian University of Technology, the Department of Transport Services Market of the Institute of Market Problems and Economic& Ecological Research of the National Academy of Sciences of Ukraine, Department of Mechanical Engineering of the Hochschule Wismar, University of Applied Science: Technology, Business and Design. Two associate partners are also involved: OOO "System Service" and Batumi Autotransport Ltd. The Ukrainian and Georgian Universities are defined as "Local Universities" for the purposes of the report.

During the proposal stage, the analysis carried out in cooperation with Ukrainian and Georgian Universities and stakeholders highlighted that there is a need to strengthen the role of research to start managing transport and logistics exploiting the opportunities offered by telematics on an evidence ‑ base in Ukraine and Georgia. For this reason, the SmaLog project aims to transfer to Ukraine and Georgia the most recent knowledge and good practices developed in the European Union in the field of smart transport and logistics for cities, and Local Universities are the key actors to start this process.

Starting from these concepts and knowledge developed by the European partners, the project aims to:

- develop and test in Ukraine and Georgia a 2-year University Masters according to the Bologna process standards;
- "Train the Trainer" supporting Local academics in defining and delivering the Masters;
- provide each Ukrainian and Georgian University with a laboratory dedicated to smart transport and logistics for cities;
- disseminate through newsletters, events, workshops and seminars the importance of research in the field of smart transport and logistics for cities;
- set up a national coordinated network of Universities, public bodies, private companies and NGOs on smart transport and logistics for cities involving Local Universities in the wider European network of research centres.

With reference to the definition of effective and useful Master curricula on smart transport and logistics, two preconditions are required to reach these aims. On the one hand, there is a need to clearly understand local conditions and needs both in terms of research and teaching on the topic in question. On the other, the need is to review and analyse the most relevant and recent experiences and tools in the field of smart transport and logistics for cities available at international level. This analysis was carried out and several important aspects were highlighted. First, the Local University system guarantees an adequate level for designing, managing and analysing smart transport and logistics.

Besides, there are some gaps. First, there is a problem of isolation from the international research world that leads to:

- a need to update contents and methods of courses for students;
- a need to update research topics in the field of smart transport and logistics for cities;
- a need of adequate technical equipment in the current laboratories, useful for the aims of a SmaLog Master.

According to the results recalled above, the new Masters programmes will be defined accordingly as a 2/1.5 years and 120/90 ECTS credit Masters with transparent quality assured contents in accordance with the Bologna process that will allow the course to be recognised within the Lisbon Convention and on a par with the European Area of Higher Education.

User Needs Analysis carried out at local level highlighted some interesting aspects. First of all,

while Masters on Transport topics are already available in Ukraine and Georgia there is no specific Masters in smart transport and logistics for cities and all the local partners agreed that research on such a topic is not fully implemented at the local level.

Finally, according to local partners, there is a lack of practical or laboratory ‐ based activities in the Masters courses. In some Masters, there are no practical or laboratory activities whatsoever, whilst in others they are not extensive and need to be improved.

To avoid administrative barriers, some local academics suggest revising/extending an existing Masters programme rather than setting up a new programme. This is a major opportunity since it will allow the delivery of the Masters from the second year of the project, and local needs can be captured in depth, exploiting the skills and competences of current teaching and research staff.

In order to improve the employment opportunities at local level of the Masters graduates, the academics from local technical universities suggest focusing first on technical and practical skills, on the use of innovative software programmes and on the international overview of the courses.

A last aspect underlined by the international review is the importance of taking into account the newest approaches on transport systems management and control.

These results have been used as inputs in the present series of deliverables whose main objective is to define the Masters Curricula both for Technical and Economic Universities in Ukraine and Georgia.

This Deliverable is organized as follows. Chapter 1 is the current chapter (Introduction). Chapter 2 describes the general structure, objectives and contents of the Master in smart transport and logistics for cities according to the original application, and normative/law constraints in partner countries (PCs) for EU recognition. Chapter 3 details the SmaLog Masters describing: Master objectives, profile of the Masters graduates, Masters Curricula, Programme structure and Equipment and material. The last section, Chapter 4, presents conclusions.

2 General structure, objectives and contents of the Masters

In order to define the general structure, objectives and contents of the Masters it is important to look at the conclusions and recommendations received during ad-hoc meetings carried out during application design and the first months after the project started. These recommendations will be used to draft the structure, objectives and contents of the Masters.

With regard to the structure of the Masters, according to the Bologna process the new Masters Programme will be defined accordingly as a two‐year 120-credit Masters with transparent quality assured content that will allow the course to be recognised within the Lisbon Convention and on a par with the European Area of Higher Education (EAHE).

Concerning the contents of the Masters the recommendations give many important inputs. First, there is the problem of isolation of Local Universities. To overcome this isolation there is a requirement to:

- Update contents and methods of courses for students with the most recent international experience;
- Update research topics in the field of smart transport and logistics for cities with the most recent international experience;
- Involve Local Universities in international research networks;
- To meet these needs, the Masters curricula will be based on the most recent and most effective training courses on smart transport and logistics existing worldwide or on research projects carried out worldwide in recent years.

Recommendations highlight a problem related to the low level of technical equipment and reference material in the current laboratories in terms of hardware, software and publications and it is important to set up SmaLog laboratories with adequate and updated equipment to this effect.

These laboratories will have a twofold use since they will be used on the one hand to improve the quality of education and, on the other, to support research.

To improve the employment opportunities at local level of the Masters' graduates it is very important to hold relevant laboratory, practical and field activities in the Masters and to include in the curricula the use of the most advanced software related to transport and logistics. For this

reason, the Masters curricula will include practical activities, laboratory activities and field activities. Moreover, the final thesis, envisaged for each Masters student, will be gered to research and practical activities rather than desk analysis.

National Transport University - NTU

The objective of the developed curricula is to provide education in the area of "Smart Transport and logistics for cities" with broad access to employment. Besides, the graduates will acquire fundamental theoretical and practical training of highly qualified specialists with in-depth knowledge to perform professional tasks and responsibilities of research and innovation in the field of "Smart Transport and logistics for cities", the ability to independently set and solve problems, scientific, practical and research activities.

The main curriculum focuses on education in the field of transport. The programme includes training in professional and practical, social and humanities disciplines, natural sciences and economics. Disciplines are developed on the basis of an integrated and systematic approach and include both special mandatory disciplines and optional disciplines.

3 SmaLog at National Transport University

3.1 Masters objectives and profile of the Masters graduates

The Masters degree in “Smart transport and logistics for cities” is developed within speciality 275 “Transport technology (in road transport)”.

3.2 Programme structure

The Masters course lasts two years for a total of 120 ECTS. According to Ukrainian Law “On Education” and the Order of the Ukrainian Ministry of Education and Science No. 1/9-126 when developing curricula, the following rules are taken into consideration (Table 1):

- 1/3 hours – class work, 2/3 hours - independent study
- Max 75% - compulsory discipline, Min 25% - free student choice
- Discipline and practice - a minimum of 3 ECTS credits. Optimal amount of discipline in the semester – 4 - 6 ECTS credits.

The curriculum consists of two parts - Compulsory and Elective.

Table 1 – Curriculum developed at NTU

Cipher	TITLE OF EDUCATIONAL DISCIPLINE	Distribution by semester				Number of ECTS credits	Number of hours						Distribution of hours per week by course and semester							
		Exams	Credit	Coursework			Total amount	Auditory				Independent study	I course		II course					
				Work	Project			Total	including:				Semesters							
									Lectures	Seminar	Laboratory		1	2	3	4				
													Number of weeks in the semester							
													15	15	15	15				
1. Compulsory part																				
1.1. General training cycle																				
1.01.	Labour protection in the industry and civil protection		1			3.00	90	30	15		15	60	2							
1.02.	Foreign language of scientific communication	1				4.00	120	30		30		90	2							
1.03.	Computer technology in transport		1			3.00	90	30	15		15	60	2							
	Total 1.1.					**10.00**	**300**	**90**	**30**	**30**	**30**	**210**	**6**							
1.2. Professional and practical training																				
1.2.1.	Smart Transport and Logistics for Cities	3			3	5.00	150	45	15	15	15	105			3					
1.2.2.	Traffic Flow Simulating and Management	3		3		6.00	180	60	30	30		120			4					
1.2.3.	Traffic Control	1			1	6.00	180	60	30	15	15	120	4							
1.2.4.	Smart Transport	2			2	6.00	180	60	30	30		120		4						

Cipher	TITLE OF EDUCATIONAL DISCIPLINE	Distribution by semester				Number of ECTS credits	Number of hours						Distribution of hours per week by course and semester							
		Exams	Credit	Coursework			Total amount	Auditory				Independent study	I course		II course					
				Work	Project			Total	including:				Semesters							
									Lectures	Seminar	Laboratory		1	2	3	4				
													Number of weeks in the semester							
													15	15	15	15				
1.2.5.	Freight Transportation Simulation	2			2	5.00	150	45	30	15		105		3						
1.2.6.	Integrated Transport System in City Logistics	3	2		3	5.00	150	45	30	15		105		2	1					
1.2.7.	Traffic Flow Management in the City Centre	3				6.00	180	45	15		30	135			3					
1.2.8.	Efficiency of City Transport Systems		2			5.00	150	45	30	15		105		3						
1.2.9.	City Passenger Transport	1			1	5.00	150	45	30	15		105	3							
Practical training																				
3.03.	Internship		4			6.00	180													
3.04.	Scientific research practice		4			6.00	180													
State attestation																				
МП	Masters Thesis					18.00	540													
	Total 1.2.					**79.00**	**2370**	**450.00**	**240.00**	**150.00**	**60.00**	**1020.00**	**7.00**	**12.00**	**11.00**					
	TOTAL 1					**89.00**	**2670**	**540.00**	**270.00**	**180.00**	**90.00**	**1230.00**	**13.00**	**12.00**	**11.00**					
2. Elective part																				

Cipher	TITLE OF EDUCATIONAL DISCIPLINE	Distribution by semester				Number of ECTS credits	Number of hours						Distribution of hours per week by course and semester							
		Exams	Credit	Coursework			Total amount	Auditory				Independent study	I course		II course					
				Work	Project			Total	including:				Semesters							
									Lectures	Seminar	Laboratory		1	2	3	4				
													Number of weeks in the semester							
													15	15	15	15				
2.1. Block of professional disciplines 1																				
3.01.	Supply Chain Management	2		2		4,00	120	45	30	15		75		3						
2.01.	Project analysis		1	1		4,00	120	30	15	15		90	2							
2.02.	Methods of scientific research		1			4,00	120	45	30	15		75	3							
2.03.	Economics of traffic organization		3			4,00	120	30	15	15		90			2					
4.02.	Transport planning of large and very large cities	2				5,00	150	45	30	15		105		3						
4.05.	Outsourcing of logistic services in transport		3			5,00	150	30	15	15		120			2					
2.04.	Human and Environmental Impacts, Safety and Sustainability		3			5,00	150	45	30	15		105			3					
	Total 2.1.1.					**31.00**	**930**	**270.00**	**165.00**	**105.00**		**660.00**	**5.00**	**6.00**	**7.00**					
2.2. Block of professional disciplines 2																				
2.01.	Project analysis		1	1		4.00	120	30	15	15		90	2							
4.02.	Transport planning of large and largest cities	2				4.00	120	45	15	30		75		3						
4.06.	Telematics control of traffic.		1			4.00	120	45	15		30	75	3							

Cipher	TITLE OF EDUCATIONAL DISCIPLINE	Distribution by semester				Number of ECTS credits	Number of hours						Distribution of hours per week by course and semester							
		Exams	Credit	Coursework			Total amount	Auditory				Independent study	I course		II course					
				Work	Project			Total	including:				Semesters							
									Lectures	Seminar	Laboratory		1	2	3	4				
													Number of weeks in the semester							
													15	15	15	15				
4.05.	Outsourcing of logistic services in transport		3			5.00	150	30	15	15		120			2					
4.04.	Organization of transport services and safety of the transport process		3			5.00	150	45	30	15		105			3					
4.06.	Supply Chain Management	2		2		4.00	120	45	30	15		75		3						
4.06.	Intermodal transport technologies		3			5.00	150	30	15	15		120			2					
	Total 2.1.2.					**31.00**	**930**	**270**	**135**	**105.0**	**30.0**	**660.00**	**5.00**	**6.00**	**7.00**					
TOTAL						**120**	**360**	**810.0**	**435.0**	**285.0**	**90.0**	**1890.0**	**18.0**	**18.0**	**18.0**					
Number of hours per week													**18**	**18**	**18**					
The number of exams													**3**	**4**	**4**					
Number of credits													**4**	**2**	**3**					
Number of course projects													**2**	**2**	**2**					
Number of course work													**1**	**1**	**1**					

(*) ECTS. For the determination of the ECTS it is agreed that 1 ECTS is equivalent to 30 hours of work.

3.2.1 Compulsory part

The compulsory part counts 88 ECTS and includes - General training cycle, Disciplines of professional and practical training, Practical training and State attestation. All disciplines from the list of the project are included to the compulsory part, namely:

- MODULE 1. Smart Transport and Logistics for Cities /5 ECTS
- MODULE 2. Traffic Flow Simulating and Management /6 ECTS
- MODULE 3. Traffic Control /6 ECTS
- MODULE 4. City Passenger Transport /5 ECTS
- MODULE 5. Freight Transportation Simulation /5 ECTS
- MODULE 6. Smart Transport /6 ECTS
- MODULE 7. Integrated Transport Systems in City Logistics /5 ECTS
- MODULE 8. Smart Transport and Logistics for Cities Project /3 ECTS
- MODULE 9. Human and Environmental Impacts, Safety and Sustainability /5 ECTS
- MODULE 10. Traffic Flows Management in the City Centre / 6 ECTS
- MODULE 11. Efficiency of City Transport Systems / 5 ECTS

Compulsory part also includes Practical training (Internship and Scientific research practice; 12 ECTS) and Masters thesis (18 ECTS)

3.2.2 Elective part

The elective part counts 31 ECTS and includes the following subjects:

- Project analysis,
- Methods of scientific research,
- Supply Chain Management,
- Transport planning in large and very large cities,
- Economics of traffic organization,
- Outsourcing of logistic services in transport,

- Telematic control of traffic,
- Intermodal transport technologies,
- Organization of transport services and safety of the transport process.

To obtain the Masters degree the student has to obtain 120 ECTS. More details can be found at http://www.ntu.edu.ua/vstupnikam/specialnosti/

3.3 Educational objectives

3.3.1 Programme competencies

Integral competence

The ability to solve complex problems and problems in the field of smart transport and logistics for cities. This provides in the learning process to obtain theoretical knowledge, skills, and competencies sufficient to develop new ideas, solve complex problems in the field of transport technologies, conduct research and/or implement innovations, study laws that determine the conditions for the rational organization of transport services and transport processes.

General competencies

- The ability to initiate, develop and implement, individually or in a group, projects to improve production processes in transport.
- The ability to organize the work of a team, as well as to motivate and manage its work.
- The ability to search, process and analyze information from various sources using modern information and communication technologies.
- The ability to determine economic performance and ensure the quality of work in the development and implementation of integrated actions and projects in compliance with working conditions, the provisions of civil protection and environmental protection.
- The ability to communicate with a professional audience, to present information in oral, printed or another form in their native and foreign languages at a professional level.
- The ability to practice various theories in the field of education, effectively applying basic

pedagogical concepts.

- The ability to conduct research in the framework of narrow specialization, identify problems, set tasks and solve them using appropriate research methods.

Specific objectives of the course

- difference from other similar programmes - a practically-oriented system of education is being introduced, which involves the synergy of theoretical and practical skills to ensure the high quality of graduate training.
- the programme integrates intelligent transport and information technologies in the management of urban transport systems.

Graduates in Smart transport and logistics should be able to:

- develop, organize and implement a project on the current topic of research in the field of transport technologies;
- expand, supplement or modify existing scientific theories with their own ideas and best practices based on the synthesis of acquired knowledge and practical experience;
- collect baseline data for project implementation and perform their analysis using modern information and communication tools, interpret the results. Formulate goals, objectives, and subject to be studied;
- present the results of analysis or research in printed or another form in a foreign or native language;
- perform an economic assessment of the project, determine the direct and indirect effect;
- apply the scientific results of specialized disciplines to develop optimal conditions for the functioning of transport systems, using improved technological rules and procedures, measurement methods in order to obtain the results of scientific research;
- develop strategies for transport technologies, define design goals, performance criteria, limitations of applicability, and be able to develop new methods and means of designing transport technologies;
- find a compromise between different requirements (cost, quality, deadlines) in both long-term and short-term planning, finding optimal solutions;

- carry out the collection, analysis of scientific and technical information, domestic and foreign experience on the subject of the study;
- to carry out the development and study of theoretical and experimental models of subjects of professional activity.

3.3.2 Modules

The tables below report the modules of the SmaLog degree.

Table 2 – Professional modules of the Masters programme

Module	
Smart Transport and Logistics for Cities // Smart Transport and Logistics for Cities Project	Table 3
Traffic Flow Simulating and Management	Table 4
Traffic Control	Table 5
City Passenger Transport	Table 6
Freight Transportation Simulation	Table 7
Smart Transport	Table 8
Integrated Transport Systems in City Logistics	Table 9
Human and Environmental Impacts, Safety and Sustainability	Table 10
Traffic Flow Management in the City Centre	Table 11
Efficiency of City Transport Systems	Table 12

Table 3 – Smart Transport and Logistics for Cities // Smart Transport and Logistics for Cities Project

Title	Smart Transport and Logistics for Cities // Smart Transport and Logistics for Cities Project
Number of ECTS	5 ECTS // 3 ECTS
Year and semester	2nd year, 3rd semester
Lecturer	Prof. Lidia Savchenko, Prof. Olexander Kosharniy
Teaching method	Classroom teaching
Examination procedure	Written and Oral
Project foreseen	Individual project
Aim	To obtain the knowledge and skills regarding smart transportation and logistics for cities. Objective: to define the challenges in urban transportation systems namely passenger transportation, freight transportation, traffic taking into consideration intelligent transportation systems and new technologies. Competences: to analyze and justify modern techniques concerning the transportation process in cities; etc. Learning outcomes: improvement of approaches and methods for research and control of the operation of integrated transport systems in cities, namely freight, passenger transportation; etc.
Contents of part 1	**Stakeholder analysis and the role of the public sector:**

Transport Systems in Urban Infrastructure	Differences between types of urban area. Road congestion. Conflict between UFT and pedestrians. Environmental pollution. Economic efficiency in urban distribution. **The urban freight and passenger transport markets in Ukraine and the EU** Retail (including e-commerce). Courier and post. Construction. Waste Regulatory measures. Market-based measures. Land use planning measures. Infrastructure measures. New technologies. Management and other measures. **European policy on urban transport** Efficient deliveries. Low emission vehicles. Intelligent Transport Systems. Night deliveries. Intermodal transfer facilities. Sustainable Transport Strategies. City Logistics in Urban Centre. Traffic and Environmental Impacts. Electrification of Public Transport in cities. Telematics tools for supporting network users.
Contents of part 2 **Theory Transport Processes and Systems of Cities**	**Transport System in an ITS Context** Network models and their use in transport. Static simulation of transport network. Traffic flow theory. Demand models. Elements for the Evaluation and Comparison of Transportation System Projects
Contents of part 3 Trends of Smart Transport and Logistics	**Intensive applications of ICT** Intensive applications of ICT and Intelligent Transportation Systems. Methods and tools of ICT and ITS for supporting planners and travellers in the management and fruition of multimodal network. Logical and functional architecture with particular attention to smart cities. ITS in urban freight transport and traffic (Freight transport management systems: fleet management systems and tracking & tracing systems, access control systems, traffic management and information systems)
Text books	1. Cascetta, E. (2009). Transportation Systems Analysis: Models and Applications. Springer. 2. Ortúzar S, J. D. D. and Willumsen, L. G. (2001). Modelling transport. Chichester New York, J. Wiley. 3. Nuzzolo, A. and Lam, W. H. K. (eds. 2017), Modelling Intelligent Multi-Modal Transit Systems, CRC Press, Taylor & Francis Group, Boca Raton (FL, USA) 4. DG MOVE. European Commission: Study on Urban Freight Transport. FINAL REPORT. MDS Transmodal Limited in association with Centro di ricerca per il Trasporto e la Logistica (CTL), 2012. 5. City Logistics Research. A Transatlantic Perspective. Summary of the First EU-U.S. Transportation Research Symposium. Transportation Research Board of the National Academies, Conference Proceedings 50, 2013, 98 P. (p. 18) 6. The Seventh Framework Programme for R&D, Theme 3 "Information and Communication Technologies". Smart freight transport in urban areas. Available at http://www.smartfreight.info .
Support tools	R-project PTV Visum Pupil world camera Regression analysis Analysis methods Mobile Mapping Systems MS Office (Excel, Word, PowerPoint)

Table 4 – *Traffic Flows Simulating and Management*

Title	Traffic Flow Simulating and Management
Number of ECTS	6 ECTS
Year and semester	2nd year, 3rd semester
Lecturer	Prof. Dzuba Olexander, As. Koliada Oksana
Teaching method	Classroom teaching

Examination procedure	Written and Oral
Project foreseen	Individual project
Aim	The ability to identify and apply promising areas of modelling urban transport systems, taking into account the latest knowledge and best practices in the field of intelligent transport and logistics
Contents of part 1 Traffic Flow Simulation	**Transport flow and its main characteristics** Basic concepts and definitions. Accidental character of the formation of traffic flows. The main characteristics of the movement and the ratio between them. **Processing results of traffic flow research** System approach in solving the problems of studying traffic flows of cars. Laws of distribution. Using methods of mathematical statistics. Estimation of statistical aggregates. Discrete distributions, continuous distributions. Hypotheses tests on the transport. Criteria of appurtenance. **The main models of traffic flow** The concept of the model. Classification of models. Model in a systematic study. The theory of motion of a single vehicle. Micro and macro models of traffic flow **Investigation of patterns of traffic flow by the modelling method** Simulation of the flow of cars. The principles of modelling the arrival and movement of single cars. Simulation algorithm. Software. Source data and analysis of simulation results
Contents of part 2 Assessment of Traffic Impacts	**Traffic management strategy** The main provisions of the strategy of traffic flow management. Management strategy to ensure throughput. Ramp meter. Detecting congestion and accidents **Information influence on traffic flows** The concept of information. Road conditions and psycho-physiological state of the driver. Information support for traffic management. Road traffic as an subject of management. Road signs. Road marking. Visual orientation. Traffic lights **Effect of information transmission systems** The information management system. Automated traffic control system. Dispatch management. Traffic information and navigation systems. Information support in special conditions.
Contents of part 3 Traffic Flow Management in Cities	**General provisions of automated traffic management** Road traffic: traffic and pedestrian flows as a focus of management. Topicality of automated traffic control. Purpose and criteria for management. The target function. The generalized structure of the automated traffic control system. **Composition, functions and structure of automated traffic management systems in cities** Technical and mathematical management tools. Managing influences. Classification of management methods. Classification of urban automated traffic control system by purpose, structure and configuration. Equipment for automated traffic control system. Automated traffic control system with microprocessor technology **Technology of traffic control in urban automated traffic control systems** The classification of management algorithms. Technological algorithms of the local level. Technological system-level algorithms. Special technological algorithms. Service algorithms
Text books	1. Traffic Engineering Design. Principles and Practice. Second edition. (2005) Mike Slin, Elsevier Ltd; 2. Системологія на транспорті: Підручник: У 5 кн. – К.: Знання України, 2005 – Кн. IV: Організація дорожнього руху / Е.В.Гаврилов, М.Ф.Дмитриченко, В.К.Доля, О.Т.Лановий, І.Е.Линник, В.П.Поліщук. 2007. – 451 с.; 3. Організація та регулювання дорожнього руху: підручник / за заг. ред. В.П.Поліщука. – К., Знання України, 2011. - 467 с.; 4. Urban Transportation and Logistics: Health, Safety, and Security Concerns 5. TOWARDS ZERO Ambitious Road Safety Targets and the Safe System Approach (JTRC). – ISBN 978-92-821-0264-0 OECD/ITF, 2009. 6. Vukan R. Vuchic Transportation for Livable Cities 7. Manual for the design of road traffic facilities: HBS 2015 / FGSV; Part A: Highways

	8. Транспортне планування міст / за заг. ред. В.П. Поліщука - Київ: Знання України, 2013./ Транспортне планування міст /Поліщук В.П., Красильнікова О.В., Дзюба О.П. - 317 с.; 9. HIGHWAY CAPACITY MANUAL 2010
Support tools	PTV Vissim Algorithms and methods of mathematical statistics Algorithm and methods for processing the results of video observation Synthesis of domestic and foreign information sources Radars for traffic data collection

Table 5 – Traffic Control

Title	Traffic Control
Number of ECTS	6 ECTS
Year and semester	1st year, 1st semester
Lecturer	Full Prof. Volodymyr Polishchuk Prof. Serhii Yanishevskiy
Teaching method	Classroom teaching
Examination procedure	Written and Oral
Project foreseen	Individual project
Aim	The ability to conduct research on the functioning of urban transport systems, identify problems, set and solve tasks that are oriented towards the integration of intelligent transport and information technologies in the management of such systems
Contents of part 1 General methodological provisions for traffic control	**Systems approach in traffic management** Definition of the concept of "road traffic". "Car - driver - road environment" system. Formation of a traffic flow. The structure and connections of the "Road Conditions - Transport flows" system Management of the system "Road conditions - Transport flows". Information as the basis of such management. **Transport flow** Intensity of movement, concept, units of measurement. Composition of traffic flow, its structure and definition. Instantaneous and average traffic flow velocity. Distributions of speeds in cross-section and length of the section. Traffic density. The fundamental diagram of the traffic flow, its characteristic and the analysis of motion in different density conditions. Tracking interval and its use for solving traffic control problems. **Throughput** Throughput of the traffic lane, plot of movement, intersection. Spatial, temporal and probabilistic nature of the throughput. Loading level, traffic conditions and traffic flow status. **Transport studies and traffic forecasting** Task and classification of transport research. Research methods for traffic flow characteristics. Study of pedestrian and bicycle traffic. Processing of study results. Forecasting data, forecasting methods, accuracy of forecasting
Contents of part 2 Traffic control with street and road interchanges	**Interchanges of streets and roads of the same level** The concept and classification of the intersection. The complexity of the intersections, conflict points. Simplified diagram of traffic at intersections. Light traffic control. Ring interchanges at intersections. Channel intersections and switching on the road network. Practical ways to control left-turn movement. **Interchanges of streets and roads at different levels** Classification of road junctions at different levels, traffic patterns and controls. The main types of road junctions at different levels. Structure of the road junction. Substantiation of geometric elements of road junctions at different levels. Expressway lanes and pedestrian mobility lines at road junctions; calculation of their parameters.

Contents of part 3 Practical aspects of traffic management	**Analysis and evaluation of traffic conditions** General estimation of traffic conditions (loading, road conditions, visibility, lighting,). Analysis of intensity and speed of movement. Speed of city passenger transport depending on traffic conditions. Transport time expenditures on the main street networks of cities and traffic delays on them. **Road traffic control methods and measurements** Basic methods of traffic management. Segregation of traffic flow by composition. Homogeneity of traffic flow and ways to increase it. One-way and reversing traffic. Methods of pedestrian traffic management. Longitudinal pedestrian traffic. Transverse pedestrian traffic. Zonal restrictions of vehicle traffic. Pedestrian zones: classification, size, arrangement, negative effects. **Road safety assessment** Road safety and the main directions of its maintenance. Normative documents on road safety. The concept, classification and analysis of road accidents. Estimation of the level of road safety based on road accident data. Costs of road accidents. The main measures for reducing the number of road accidents. Forecasting a reduction in the number of road accidents after the implementation of measures to improve traffic management.
Text books	1. Traffic Engineering Design. Principles and Practice. Second edition. (2005) Mike Slin, Elsevier Ltd; 2. Системологія на транспорті: Підручник: У 5 кн. – К.: Знання України, 2005 – Кн. IV: Організація дорожнього руху / Е.В.Гаврилов, М.Ф.Дмитриченко, В.К.Доля, О.Т.Лановий, І.Е.Линник, В.П.Поліщук. 2007. – 451 с.; 3. Організація та регулювання дорожнього руху: підручник / за заг. ред. В.П.Поліщука. – К., Знання України, 2011. - 467 с.; 4. Urban Transportation and Logistics: Health, Safety, and Security Concerns 5. TOWARDS ZERO Ambitious Road Safety Targets and the Safe System Approach (JTRC). – ISBN 978-92-821-0264-0 OECD/ITF, 2009. 6. Vukan R. Vuchic Transportation for Livable Cities 7. Manual for the design of road traffic facilities: HBS 2015 / FGSV; Part A: Highways 8. Транспортне планування міст / за заг. ред. В.П. Поліщука - Київ: Знання України, 2013./ Транспортне планування міст /Поліщук В.П., Красильнікова О.В., Дзюба О.П. - 317 с.; 9. HIGHWAY CAPACITY MANUAL 2010
Support tools	Synthesis of domestic and foreign information sources Algorithms of simulation modelling and methods of PTV Vissim Technique of carrying out and processing results of full-scale observations Methods of analysis of an accident

Table 6 – City Passenger Transport

Title	City Passenger Transport
Number of ECTS	5 ECTS
Year and semester	1st year, 1st semester
Lecturer	Prof. Oksana Gulchak
Teaching method	Classroom teaching
Examination procedure	Written and Oral
Project foreseen	Individual project
Aim	To acquire the knowledge concerning methods of formation and modeling of city passenger flows, assessment of quality of functioning of city transport systems (PTV Vision) Methods of modelling urban passenger correspondence using software product PTV Vision. Determination of passenger travel time in the route system using PTV Vision. Coordination of various types of public transport using VISUM. Customize individual vehicle redistribution options in VISUM. Ability: - to manage passenger transportation by type of transport; - to simulate route systems.
Contents of part 1	Strategies for demand management for transport services. Models of transport demand. Coordination

Passenger Transportation Management	of various types of public transport by using VISUM. Distribution of trips by type of transport and analysis of transport choice mode. Factors influencing the performance of urban passenger transport. Customize individual vehicle redistribution options in VISUM. Manage the route. High-speed transport.
Contents of part 2 Human Factor in Passenger Transportation	Laws of perception of the driver of road conditions. Influence of planning features of routes on the driver's condition. Dynamics of changes in the ability to work during a working day. Ways to increase the reliability of work on the basis of the use of patterns of driver perception of road conditions. Influence of traffic conditions on the psycho-physiological state of the passenger. Determine the attractiveness of routes using fuzzy logic.
Contents of part 3 Routing Systems Simulation	Factors determining the demand for transportation. Methods of formation of passenger flows. Methods of modelling urban passenger correspondence using software product PTV Vision. Optimization models of city transport system formation. Determination of passenger travel time in the route system using PTV Vision. Methodology for assessing the quality of functioning of city transport systems.
Text books	1. Cascetta, E. (2009). Transportation Systems Analysis: Models and Applications. Springer. 2. Ortúzar S, J. D. D. and Willumsen, L. G. (2001). Modelling transport. Chichester New York, J. Wiley. 3. Nuzzolo, A. and Lam, W. H. K. (eds. 2017), Modelling Intelligent Multi-Modal Transit Systems, CRC Press, Taylor & Francis Group, Boca Raton (FL, USA) 4. DG MOVE. European Commission: Study on Urban Freight Transport. FINAL REPORT. MDS Transmodal Limited in association with Centro di ricerca per il Trasporto e la Logistica (CTL), 2012. 5. Slinn M., Matthews P., Guest P. Traffic Engineering Design Principles and Practice. Second edition. — Elsevier Butterworth-Heinemann, 2005. 241 p.
Support tools	PTV Vision MS Office (Excel, Word, PowerPoint)

Table 7 – Freight Transportation Simulation

Title	Freight Transportation Simulation
Number of ECTS	5 ECTS
Year and semester	1st year, 2nd semester
Lecturer	Full Prof. OleksandrKotsyuk
Teaching method	Classroom teaching
Examination procedure	Written and Oral
Project foreseen	Individual project
Aim	Knowing methodological, theoretical and applied basic contents of planning and operative management of freight transport systems and logistics in cities. Competence: Students will have acquired the skills for analyzing and solving problems related to the planning and management of freight transport systems and logistics at extra-urban level. Learning outcomes Teaching will provide the students with the skills: - to face, formalize and resolve autonomously a decision-making problem in the field of planning on real cases, and operational management of freight and logistics systems. - to substantiate of feasibility of measures for improvement of transport process using simulation tools (methods and models). - to identify and analyze the fundamental aspects of extra-urban freight transport and of design and assessment of projects on freight nodes. Ability to perform the analysis and calculation of economic indices of supply chain activity and logistics centres.
Contents of part 1 Freight transportation	**Logistics and supply chain** (The supply chain: Structure and functionalities of a logistics network, Problem classifications, Distribution strategies). **Freight transportation** (Freight mode and transport costs, Logistics costs and mode choice).

	Freight nodes (Definition, classification and functions of freight node).
Contents of part 2 Demand forecasting	**Transport data Analysis and freight demand models** (Ports within the supply chains and the revolution of container). **Multi Regional Input Output models** (Estimation of Origin - Destination matrices). **Modal split** (Aggregate / disaggregate models, consignment and logistics models).
Contents of part 3 Assessing freight scenarios	**Design of freight nodes** (Effect classification, Financial analysis, Benefit-Cost Analysis, Multi-Criteria analysis, Technical-Economic feasibility studies). **Freight transport planning** (Example of freight plans).
Text book	1. Tavasszy, L. and De Jong, J. (eds; 2014), Modelling Freight Transport, Elsevier, ISBN: 978-0-12-410400-6, 2014 2. Ben Akiva, M., Hilde Meersman and Eddy Van de Voorde (eds.; 2013), Freight Transport Modelling, Emerald Group Publishing Limited. 3. Rodrigue, J.P. (2013). The Geography of Transportation Systems. Routledge - Taylor & Francis Group. 4. Cascetta, E. (2009). Transportation Systems Analysis: Models and Applications. 2nd edition. Springer. 760 p 5. Daganzo, C. F. (1991). Logistics Systems Analysis. Springer-Verlag. 6. Nuzzolo, A., Crisalli, U. and Comi, A. (2015). An aggregate transport demand model for import and export flow simulation. In Transport 30 (1), DOI:10.3846/16484142.2013.820215, Francis & Taylor, 43-54 7. Nuzzolo, A., Crisalli, U. and Comi, A. (2013). Ex-ante assessment of road transport emissions: application to the Italian case. In External costs of transport systems: theory and applications – Selected papers, U. Crisalli, E. Cipriani and G. Fusco (eds.), Franco Angeli Editore, Milan, chapter 14, 210 – 224. 8. Russo, F., Vitetta, A. and Comi, A. (2009). Estimation of target time distribution for agri-food products by road transport. In Schedule-Based Modeling of Transportation Networks: Theory and Applications, N. H. M. Wilson and A. Nuzzolo (eds.), DOI: 10.1007/978-0-387-84812-9_14, Springer Science + Business Media, 267 – 283. 9. Ben-Akiva M., de Jong G. (2008), The Aggregate-Disaggregate-Aggregate (ADA) Freight Model System, in Ben-Akiva M., Meersman H., & van der Voorde E., Eds., Recent Development in Transport Modelling –Lessons from freight sector , chapter 7, Emerald Group Publishing Ltd. 10. Polimeni, A., Russo, F., Vitetta, A., (2010). Demand and routing models for urban goods movement simulation. *European Transport* , 46, pp. 3 – 23. 11. Nuzzolo, A., Comi, A., (2014). City Logistics Planning: Demand Modelling Requirements for Direct Effect Forecasting. *Procedia - Social and Behavioral Sciences*, Volume 125, 20 March 2014, pp. 239 – 250. 12. Nuzzolo, A., Comi, A., (2015). Modelling challenges to forecast urban goods demand for rail. *Transport Problems*, 10 (4). pp.75 – 90.
Support tools	*PTV Visum* *AnyLogic* *Statgraphics* *MS Office*

Table 8– Smart Transport

Title	Smart Transport
Number of ECTS	6 ECTS
Year and semester	1st year, 2nd semester
Lecturer	Prof. Lidiia Savchenko Assistant prof. Oleksandr Kosharnyi
Teaching method	Classroom teaching

Examination procedure	Written and Oral
Project foreseen	Individual project
Aim	To obtain the knowledge and skills regarding smart transport. Objective: to define the challenges in urban transportation system namely passenger transportation, freight transportation, traffic taking into consideration intelligent transportation systems and new technologies. Competences: to analyze and justify modern techniques concerning transportation process in the cities. Learning outcomes: improvement of approaches and methods for research and control of the operation of the integrated transport systems in the cities namely freight, passenger transportation; etc.
Contents of part 1 Information Technologies in Traffic Management	Road traffic monitoring systems Traffic intensity, speed of traffic in real time. Traffic management decisions in real-time. Methods of road traffic research. Methods of vehicles registration on the road. Video monitoring of traffic. Traffic management centres. Road traffic control Road traffic speed systems control , speed measurement. Road speed limit enforcement. Automatic number-plate recognition. Vehicle recognition identification. Electronic toll collection systems. Traffic control systems to help monitor the movement and flow of vehicles on the road network. Control and guide for drivers Road signs, road surface marking, information to drivers and pedestrians. Online information for car park usage, pedestrian crossing usage, areas of low and high congestion, frequency, location and cause of road works. Network and traffic management systems ITS for the road network. Monitoring methods and technologies. Urban traffic management
Contents of part 2 Intelligent traffic safety systems	Classification of vehicle safety systems Classification of electronic vehicle safety systems. Electronic systems used in road vehicles: engine electronics, transmission electronics, chassis electronics. Passenger comfort. Infotainment systems. Active safety of vehicles Anti-lock braking system, electronic stability control, chassis assist, intelligent speed adaptation, brake assist, traction control, collision warning avoidance, adaptive or autonomous cruise control system. Passive safety of vehicles Passenger safety cell, deformation zones, seat belts, loadspace barrier-nets, air-bags, laminated glass, correctly positioned fuel tanks, fuel pump kill switches. Crash test car. Modern traffic safety systems System to prevent crashes caused by fatigue. Monitoring of the functional state of the driver. Sobriety detectors. Driver assistance systems that help the driver detect obstacles and drive a vehicle. Autonomous car. Safety of vehicles in the future.
Contents of part 3 Satellite Navigation Systems in Transport	Classification of satellite navigation systems Civil and military uses. Global navigation satellite systems (GPS, GLONASS, Galileo, BeiDou-2). Regional navigation satellite systems (BeiDou-1, NAVIC, QZSS). Principles of satellite navigation systems operation Basic elements of satellite navigation. Working principles. Coordinate system. The system of time. Navigation radio signals. Factors that affect the accuracy of positioning. Means for increasing the accuracy of positioning. Monitoring of vehicle traffic parameters by satellite navigation. Transport management using satellite navigation systems Features of application of navigation systems on transport. Features of navigation systems. Information support for navigation systems. Control of the operation of transport using navigation systems. Selection of traffic routes. Simulation of transport parameters by means of satellite navigation systems.
Textbook	1. Cascetta, E. (2009). Transportation Systems Analysis: Models and Applications. Springer. 2. Ortúzar S, J. D. D. and Willumsen, L. G. (2001). Modelling transport. Chichester New York, J.

	Wiley. 3. Nuzzolo, A. and Lam, W. H. K. (eds. 2017), Modelling Intelligent Multi-Modal Transit Systems, CRC Press, Taylor & Francis Group, Boca Raton (FL, USA) 4. DG MOVE. European Commission: Study on Urban Freight Transport. FINAL REPORT. MDS Transmodal Limited in association with Centro di ricerca per il Trasporto e la Logistica (CTL), 2012. 5. City Logistics Research. A Transatlantic Perspective. Summary of the First EU-U.S. Transportation Research Symposium. Transportation Research Board of the National Academies, Conference Proceedings 50, 2013, 98 P. (p. 18) 6. The Seventh Framework Programme for R&D, Theme 3 "Information and Communication Technologies". Smart freight transport in urban areas. Available at http://www.smartfreight.info .
Support tools	PTV Visum Pupil world camera Regression analysis Analysis methods Mobile Mapping Systems

Table 9 – Integrated Transport Systems in City Logistics

Title	Integrated Transport Systems in City Logistics
Number of ECTS	5 ECTS
Year and semester	1st year, 2nd semester – 2nd year, 3rd semester
Lecturer	Prof. Olga Kunytska
Teaching method	Classroom teaching
Examination procedure	Written and Oral
Project foreseen	Individual project
Aim	To obtain the knowledge and skills regarding the analysis of urban freight transport and city logistics management. **Competence** Ability to research and manage city logistics. **Learning outcomes** After study the course the students will be able: ✓ to improve approaches and methods for studying and managing the operation of integrated transport systems. ✓ to develop measures on cargo transportation management using modelling of freight transportation processes by transport modes. ✓ to substantiate necessity of measures on improvement of transport technologies with the use of modelling of transport processes. To evaluate the effectiveness of selected activities.
Contents of part 1 Principles of urban goods movements	**Principles of Urban goods movements** (Infrastructure problems, Goods transportation and traffic problems, Delivery periods, Urban freight transport sustainability, General typology of last-mile deliveries). **E-commerce** (Trends, performances, infrastructures and delivery structure). **Distribution centres and warehouses** (The scope of the warehousing problem in the city area, Rational location determination, The scenarios of location in the case of transport modes, City transit impacts).
Contents of part 2 Urban goods modelling	**Identification of actors and choice dimensions** (Characteristics of the goods transportation actors, Definition of utility function, Transport service and modal choice utility functions, Probability of mode choice). **Shopping mobility: surveys** (Definition of methods for revealing shopping mobility activities). **Freight distribution: surveys** (Definition of methods for revealing freight distribution mobility activities).

	Urban goods movements: integrated modelling (Urban goods movement in city transit, Constraints to urban goods movement). **Routing and schedule models** (General statement of city freight transportation routing, Iterated Nearest Insertion Algorithm, Genetic Algorithm, The vehicle routing and scheduling problem with time windows).
Contents of part 3 City logistics scenario assessment	**Impacts of the integrated transport system** (Identification of relevant impacts, Identification and estimation of impact indicators of ITS, Computation of users' surplus changes, Benefit-cost analysis, Revenue-cost analysis). **City logistics measures** (Urban goods movements and relevant actors, Material infrastructure measures, Immaterial infrastructure measures, Equipment measures, Governance measures). **Freight distribution: surveys** (City logistics planning objectives, Formulation and ex-ante assessment of alternative planning scenario, Direct effect target and outcome indicators).
Text books	1. Eiichi Taniguchi, Russell G. Thompson (2001) City Logistics: Network Modelling and Intelligent Transport Systems, 264 2. Cascetta, E. (2009). Transportation Systems Analysis: Models and Applications. 2nd edition. Springer. 760 p 3. Nuzzolo, A., Comi, A., (2014). City Logistics Planning: Demand Modelling Requirements for Direct Effect Forecasting. *Procedia - Social and Behavioral Sciences*, Volume 125, 20 March 2014, pp. 239 – 250. 4. Nuzzolo, A., Comi, A., (2015). Modelling challenges to forecast urban goods demand for rail. *Transport Problems*, 10 (4). pp.75 – 90. 5. Guidebook for Understanding Urban Goods Movement (2012) 6. Diego Cattaruzza, Nabil Absi, Dominique Feillet, and Jesús González-Feliu (2017) Vehicle Routing Problems for City Logistics 7. Khisty C.J., Lall B.K. (2002) Transportation Engineering. An Introduction. Third Edition. Prentice-Hall. 8. Sinha K.C., Labi S. (2007) Transportation Decision Making: Principles of Project Evaluation and Programming. Wiley.
Support tools	*PTV Visum* *AnyLogic* *Statgraphics* *MS Office*

Table 10– Human and Environmental Impacts, Safety and Sustainability

Title	Human and Environmental Impacts, Safety and Sustainability
Number of ECTS	5 ECTS
Year and semester	2nd year, 3rd semester
Lecturer	Prof. Oksana Semenchenko
Teaching method	Classroom teaching
Examination procedure	Written and Oral
Aim	To acquire knowledge to determine the economic, social and environmental impacts of transport systems on urban logistics. Alternatives to mobility for all residential areas of cities. Improving the quality of public transport. Investment attractiveness of public transport. Influence of the transport system on the level of environmental pollution. Ability: - to manage the reliability and efficiency of transport technologies by type of transport; - to evaluate transport systems in urban infrastructure; - determining the impact of transport on the environment.
Contents of part 1	Urban logistics system planning taking into account the impact on the environment. Factors

Environmental Impacts	influencing the environment on transport policy. The relationship between transport and quality of public places. Account of regional conditions in the formation of transport networks. Formation of a sustainable transport system.
Contents of part 2 Reliability and Safety of City Logistics	The role of the human factor in ensuring the reliability of the operation of transport systems. Fundamentals and general provisions of the theory of reliability. Operability and reliability of the operator-operator in the system of city logistics. Methods of assessing the safety of traffic on the road network of cities. Accident and Human Factor Accident Criterion. Immediately increasing the reliability of the operation of urban logistics systems.
Contents of part 3 Traffic Psychology and Human Machine Interface	Features of human activity in the system of LTPs. Methodological features of road psycho-physiological research. Model for forming the reaction time of the driver. Psycho-physiological states of the driver and their classification. Conditions of work and environment as a factor affecting the functional state of the driver. Use of computer technology to determine the indicators of the functional status of participants in the transport process. Assessment of psycho-physiological features of drivers using "CardioSens" and "Neurocom" complexes. Modelling the process of driving a vehicle using simulators. Ergonomic support in the field of transportation.
Text books	Agrawal, A. (2002). Common resources and institutional sustainability. In E. Ostrom, E., Th. Dietz, N. Dol˘sak, P. C. Stern, S. Stonich, & E. U. Weber (Eds.), The drama of the commons. Washington DC: National Academies Press. Alcott, B. (2005). Jevons' paradox. Ecological Economics, 54, 9–21. Bandura, A. (2002). Environmental sustainability by sociocognitive deceleration of population growth. In P. Schmuck & W. Schultz (Eds.), Psychology of sustainable development. Norwell, MA: Kluwer. Bazerman, M. H., Wade-Benzoni, K. A., & Benzoni, F. J. (1996). Environmental degradation: Exploring the rift between environmentally benign attitudes and environmentally destructive behaviors. In D. M. Messick & A. E. Tenbrunsel (Eds.), Codes of conduct: Behavioral research into business ethics. De Young, R. (1993). Changing behavior and making it stick. The conceptualization and management of conservation behavior. Environment and Behavior Dittmar, H. (1992). The social psychology of material possessions. To have is to be. London: Harvester Wheatsheaf. Edney, J. J. (1980). The commons problem; alternative perspectives.

Table 11 – Traffic Flow Management in the City Centre

Title	Traffic Flow Management in the City Centre
Number of ECTS	6 ECTS
Year and semester	2nd year, 3rd semester
Lecturer	Prof. Volodymyr Eresov
Teaching method	Classroom teaching
Examination procedure	Written and Oral
Aim	The ability to manage the reliability and efficiency of road traffic in the central parts of cities, taking into account the latest knowledge and best practices in the field of intelligent transport and logistics
Contents of part 1 Trends of Traffic Flow Management in the City Centre	**Local management of traffic flows** Traffic light traffic control at a separate intersection. Adjustment by phases (steps). Adjustment by signalling groups. Rigid software management. Adaptive software control. **System management of traffic flows** Coordinated traffic control. Parameters of the coordination programme and their definition. Rigid coordinated management. Adaptive coordinated management. **Management of the of city shuttle passenger traffic** Provision of priority traffic of city shuttle passenger transport. Contact and non-contact priority of travel. Application of smart transport systems for traffic control. Information system for passengers.

	Pedestrian control Pedestrian control on regulated and unregulated areas. Light traffic control taking into account the characteristics of pedestrian streams. Organization of pedestrian traffic and underground pedestrian traffic. Information systems for pedestrians. Securing the pedestrian movement **Organization and management of bicycle traffic** Organization of cycling on the lines of traffic and intersections. Light traffic control with regard to cycling. Organization of parking places for bicycles. Information system for cyclists. Ensuring the safety of cycling. **Organization of the movement of persons with disabilities** Arrangement of ramps at crossroads, over ground and underground pedestrian crossings. Sound signals at regulated intersections. Use of tactile signals on sidewalks, intersections and stops of public transport. **Transport management systems using smart-transport systems technologies** Transport traffic management on the city streets through the TRANSYT method. Automated centralized intelligence systems (SCOOT, SCATS). Automated control systems with decentralized intelligence (MOTION). The appointment of intelligent transport systems and their hierarchy. Navigation systems. Subsystem of traffic control in dangerous situations. Subsystem of informational support of movement participants .
Contents of part 2 Parking in the City Centre	**Classification and characteristics of car parking** Parking features in cities. Classification of parking lots. Mode of storage and duration of finding cars in the parking lot. Features of stopping cars on the street-road network. Multi-level Parking. Planning characteristics of parking lots. Schemes of car placement. Determine the number of cars and the area of one car on the parking lot. Width of fares. Radius of turns. Maneuvering zones **Using technologies of smart-transport systems in the organization of automobile parking lots** Payment methods for using a car park. Design zones of paid parking. Parking facilities. Parking and parking features like "Park and Ride". Park and Ride parking management system. Technical subsystems of parking "Park and Ride" type. **Multi-level parking** Features of the organization of parking in the city centre. The ratio of the level of motorization to the number of parking places. Definition of the area and type of parking in the city centre. Capacity of multi-level parking in central cities. Parking plans. Providing drivers with information on availability of free places.
Contents of part 3 Environmental Management	**European standards for environmental protection in cities** International standard ISO 14000 Environmental Management. European emission standards (Euro 6) **Environmental management within the city's smart-transport system** Subsystem of collection and processing of information on toxic emissions of transport flows. Subsystem of organization of traffic taking into account the requirements of environmental protection.
Text book	1. Traffic Engineering Design. Principles and Practice. Second edition. (2005) Mike Slin, Elsevier Ltd; 2. Системологія на транспорті: Підручник: У 5 кн. – К.: Знання України, 2005 – Кн. IV: Організація дорожнього руху / Е.В.Гаврилов, М.Ф.Дмитриченко, В.К.Доля, О.Т.Лановий, І.Е.Линник, В.П.Поліщук. 2007. – 451 с.; 3. Організація та регулювання дорожнього руху: підручник / за заг. ред. В.П.Поліщука. – К., Знання України, 2011. - 467 с.; 4. Urban Transportation and Logistics: Health, Safety, and Security Concerns 5. TOWARDS ZERO Ambitious Road Safety Targets and the Safe System Approach (JTRC). – ISBN 978-92-821-0264-0 OECD/ITF, 2009. 6. Vukan R. Vuchic Transportation for Livable Cities 7. Manual for the design of road traffic facilities: HBS 2015 / FGSV; Part A: Highways 8. Транспортне планування міст / за заг. ред. В.П. Поліщука - Київ: Знання України, 2013./ Транспортне планування міст /Поліщук В.П., Красильнікова О.В., Дзюба О.П. - 317 с.;

	9. HIGHWAY CAPACITY MANUAL 2010
Support tools	Method of dilution of transport streams in time The method of searching for gaps in the transport stream. Algorithm for calculating the duration of the traffic light regulation cycle based on the ratio of traffic flow and saturation fluxes Algorithm for granting priority travel to urban route transport Algorithms of the subsystem for collecting and processing information on toxic emissions of traffic flows. Algorithms of automated control systems with centralized and decentralized intelligence.

Table 12– Efficiency of City Transport Systems

Title	Efficiency of City Transport Systems
Number of ECTS	5 ECTS
Year and semester	1st year, 2nd semester
Lecturer	Full Prof. Olexandr Lanovyi Assistant prof. Inna Vugivska
Teaching method	Classroom teaching
Examination procedure	Written and Oral
Aim	To acquire the knowledge of using the Copert program to assess the impact of transport on the urban environment and assess the reliability of urban logistics, taking into account the human factor (CardioSens) Urban logistics system planning taking into account the impact on the environment. The role of the human factor in ensuring the reliability of transport systems operation. Operability and reliability of the operator in the system of city logistics. Ergonomic support in the field of transportation. Ability: - use smart transport and logistics in cities; - to assess the reliability and safety of city logistics.
Contents of part 1 Economic Efficiency	Effective pricing policy. Factors affecting the demand for transportation. Weighted tariff system. Improvement of transport system infrastructure. Improving the quality of public transport. Investment attractiveness of public transport. Scripts of development of transport systems.
Contents of part 2 Social and Ecology Efficiency	Basic functions of the transport system. Improvement of public transport offers. Reduced travel time. Improved transportation comfort. Alternatives to mobility for all residential areas of cities. Legal bases of environmental activity. Impact of the transport system on the level of environmental pollution. Assessment of the harmful effects of cars on the environment. Regulation of rational development and land use. Efficiency of design decisions in all aspects on all blocks.
Text books	1. Johan Holmgren, The efficiency of public transport operations: An evaluation using stochastic frontier analysis, 2013 2. Системологія на транспорті: Підручник: У 5 кн. – К.: Знання України, 2005 – Кн. IV: Організація дорожнього руху / Е.В.Гаврилов, М.Ф.Дмитриченко, В.К.Доля, О.Т.Лановий, І.Е.Линник, В.П.Поліщук. 2007. – 451 с.; 3. Організація та регулювання дорожнього руху: підручник / за заг. ред. В.П.Поліщука. – К., Знання України, 2011. - 467 с.; 3. Button, K., 2010. Transport Economics, 3rd ed. Edward Elgar, Cheltenham. NOLAN, J.F. Determinants of productive efficiency in urban transit. Logistics and Transportation Review

3.3.3 Employment opportunities

Graduates who hold a Masters degree in the field of Smart transport and logistics for cities (Transport Technology (in motor transport)) may have the following professional titles (according to Ukrainian encoding):

- 2149.1 - scientific staff;
- 2149.2 - engineers;
- 2149 - professionals in other fields of engineering;
- 2310 - teachers of universities and higher educational establishments;
- 2359 - other professionals in the field of education;
- 2359.1 - other academic staff in the field of training under the Classification of Occupations are valid from November 1, 2017.

Graduates will be able to hold the following positions:

- Engineer in management and organization of transportation (II category);
- Transport engineer at transport enterprises, in the management of public and passenger transport, transport and communications management of the region, district and city administration, in research laboratories of design institutes and institutes of forensic examinations, in transport and forwarding enterprises;
- Engineer in employee training and retraining departments;
- Teacher in higher education institutions, assistant in higher educational establishments;
- Junior researcher at research and development institutions of transport, design organizations.

Graduates have the right to engage in such activities in accordance with the classifier of economic activities (КВЕД ДК 009: 2010 (2017)):

- Section "M" - Professional, scientific and technical activities, section 72 - Research and development, class 72.19 - Research and experimental development in the field of other natural and technical sciences;
- Section "H" - Transport, Warehousing, Post and Courier Activities, Section 52 Warehousing

and auxiliary transport activities, group 52.2 - Support activities in the field of transport, class 52.21 - Support services for land transport.

- Section "H" - Transport, warehousing, postal and courier activities, section 49 - Land and pipeline transport, group 49.4 - Freight transport by road, provision of transportation services, class 49.41 - Freight transport by road.

3.3.4 Prerequisites (Admission procedure):

Possession of the first (Bachelor's) degree or educational qualification level of the specialist.

3.3.5 Cycle / Level

National Qualifications Framework of Ukraine - 7th level, FQ-EHEA - second cycle, EQF-LLL - 7 level.

3.3.6 Teaching and learning

Lectures, practical classes, implementation of term papers, research laboratory works, independent work on the basis of textbooks, manuals and lecture notes, consultations with teachers, scientific seminars, demonstration classes, elements of distance (on-line, electronic) training, internship at enterprises and in research institutions, preparation of qualifying work.

3.3.7 Evaluation

Assessment methods: exams, tests, practice, control, coursework and diploma papers, essays, presentations, etc.

Format (incoming testing and current control): testing of knowledge or skills; oral presentations; laboratory work reports; analysis of texts or data; practice reports; written essays or reports (may be part of the thesis: a review of the literature, a critical analysis of publications, etc.).

Summarizing - final control:

- Exam (written with subsequent oral questioning);
- The score (based on the results of the formative control).

3.3.8 Personnel support

Masters training in the speciality SmaLog (275 Transport technologies (on motor transport)) is provided by the leading departments of the Faculty of Transport and Information Technologies and profile departments of other faculties of the National Transport University.

The implementation of the educational programme is provided by the scientific pedagogical staff of the NTU, as well as by persons involved under the terms of an employment contract.

Teachers working part-time - are leading specialists, practical workers of the economic branches, entrepreneurial and controlling structures of the region.

The total number of teachers who conduct lectures, practical and laboratory classes is 31.

Personnel structure, the system of recruitment, their use, advanced training, the dynamics of changes in the composition of scientific and pedagogical staff are all sufficient for ensuring the qualitative training of specialists at the Masters educational and qualification level.

3.3.9 Information and educational - methodical support

The Library Fund has 550,000 copies of educational, scientific and literary and artistic editions that fully meet the needs of students and can serve students who will qualify for the Masters. There is an automated library and information system that meets international standards. Electronic versions of textbooks and teaching aids of the university professorial staff are available: the volume of their

own databases is over 149,000 entries. Ensuring the educational process of literature corresponds to the current standards of provision of contingent students in the speciality. There is modern printing equipment, which allows the needs of the university in teaching materials to be met operatively.

Practical training of students

To organize the practical training of students, the university has entered into cooperation agreements with modern enterprises and institutions of the transport industry, with research and design institutions of urban planning, where they acquire the relevant skills and deepen in practice the theoretical knowledge gained at the university:

• Department of Transport Infrastructure of the Kyiv City Council (Kyiv City State Administration)

• Institute of the General Plan of the Kyiv City Council (Kyiv City State Administration) http://kievgenplan.grad.gov.ua/uk/

• "Kievpastrans" http://kpt.kiev.ua

• "Kievavtodor" https://kyivavtodor.kyivcity.gov.ua

• "Center for Traffic Organization" http://dorservise.kiev.ua

• Institute "Kievdormostproject" http://kdmp.kiev.ua

• Units of the National Police of Ukraine;

• Transport services and logistics centres of business structures in Kyiv and Ukraine.

3.4 Equipment and material

The following categories of equipment and material support students and teachers in the studying and teaching process (*Table* 13).

Table 13 – Equipment available for SmaLog students

Computers	**Quantity**	**SmaLog aims**
Impression CoolPlay I1216	10	The aim is to provide technical support for teachers and students involved in SmaLog through improvement and modernization of the technical base
20" Philips 203V5LSB26/10	10	
Peripherals		
A4 HP LaserJet Pro M227sdn (G3Q74A)	2	
Genius NetScroll 120 Optical Black ps/2	10	
Genius KB-110X Black ps/2	10	
Software		
NOD 32	10	The goal is to improve the quality of SmaLog training in all modules included in the programme.
STATGRAPHICS 18 ACADEMIC LICENSES	3	
Vizum Academic package for Education Use	1	
PTV Vissim 10 for Students		
PTV Vistro 5 for Students		
AnyLogic University Researcher	1	
One Year of Maintenance and Technical Support Services for AnyLogic University Researcher (2 years)	1	
Multimedia equipment		
BenQ MS527 (9H.JFA77.13E) (Multimedia projector)	1	Multimedia equipment which is going to be used for visualization and direct presentation
VGA ATcom M/M 15м (9152) (cable)	1	
Walfix PB-14B (Bracket for projector)	1	
Intech RD80A (Interactive board)	1	
Walfix SNM-4 120" (Projection screen)	1	
Technical training		
Voltcraft SL-451 Sound Meter 30-130 Db	1	For practical work within the Environmental Management module
OPTIMA7 NDIR	1	For practical work within the Environmental Management module
Pupil world camera	1	For practical work within the Human and Environmental Impacts, Safety and Sustainability module
Radars for TRAFFIC DATA COLLECTION	1	For practical work within Traffic Flow Management in the City Center module
XIRO Xplorer Mini Black (16096)	1	For practical work within Traffic Flow and Traffic Flow Simulation and Management
Books		
Urban Transportation and Logistics: Health, Safety, and Security Concerns		The teaching materials which is up-to-date and support Master/PhD students training
Public Transit Planning and Operation: Modeling, Practice and Behavior, Second Edition		

4 Conclusions

Obtaining education in the speciality "SmaLog" allows Masters graduates to gain broad access to employment. The programme provides for the fundamental theoretical and practical training of highly skilled personnel who acquire thorough in-depth knowledge for the fulfilment of professional tasks and responsibilities of research and innovation in the field of "SmaLog", as well as the ability to independently formulate and solve problems in scientific, practical and research spheres.

The curriculum of the SmaLog Master programme will be a basic Masters programme at the Transport Systems and Traffic Safety Department. Students enrolling on SmaLog curricula can besides benefit from the international agreements that are being set up to allow them to study and follow training activities in some European countries (submission of proposals for E+/KA1 call).