ERASMUS+ PROGRAMME
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Master in SMArt transport and LOGistics for cities / SMALOG

Grant Agreement Number 2017-2893/001-001

Master Curricula

development and implementation

at O. M. Beketov National University of Urban Economy in Kharkiv - NUUE

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 Ukrainian and Georgian Universities according to the Bologna process standards within the SmaLog project. This deliverable reports curricula developed and implemented for O. M. Beketov National University of Urban Economy in Kharkiv - NUUE. After a short introduction, the deliverable describes the local conditions, needs and the results of the international reviews on which the curricula was 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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OUTLINE

General details

Duration and start date: 2 academic years, 120 ECTS. Starting in September.
Timetable and delivery: Day-time. Blended learning: face-to-face, distance support.
Fees and grants: There are two options to finance students studying: government payment (budgetary); own student payment (contract), approximate fee is 15700 UAH per year.
Within the framework of the Erasmus+ CBHE mobility opportunities.
Language: Ukrainian, English.
Official degree: accredited by the National Agency for Higher Education Quality Assurance (Ukraine). Certificate of accreditation - № 436, valid until 16.06.2025.

Admission

General requirements: Examination procedure includes two exams: 1) external independent evaluation of foreign language; 2) internal professional entrance examination in a speciality.

General rules

Specific requirements: The Master's degree is conceived as the natural continuation of a degree in Transport Technologies. Given its scientific and professional nature, it is advisable for students to have sufficient knowledge of analysis methods and transport and logistics.
Admission criteria: Bachelor's degree, entrance exams (speciality, foreign language), academic rate.
Places: 30.
Enrolment: How to enrol (https://abit.kname.edu.ua/index.php/uk/)
Curriculum: Master in Smart Transport and Logistics (see Table 1)

Professional opportunities

Integral competence: Ability to solve complex tasks and problems in the field of transport systems and technologies, which are characterized by uncertainty of conditions and requirements involving research and innovation.
Employment: Career opportunities for graduates of this programme are found in both the public and private sectors in the fields of transport, mobility and logistics. Working places could be universities or scientific organizations, scientific positions in communication, transportation, management, state institutions, private companies, consulting etc. Teachers' positions in the institutions of higher education could be a work opportunity.

Official regulations:

Official description of Scientific and Education programme:
(https://tsl.kname.edu.ua/images/files/OK/RT_ONP.pdf)
Regulatory framework of university
(https://www.kname.edu.ua/index.php/%D0%B3%D0%BE%D0%BB%D0%BE%D0%B2%D0%B

D%D0%B0/%D0%BD%D0%BE%D1%80%D0%BC%D0%B0%D1%82%D0%B8%D0%B2%D0%BD%D0%B0-%D0%B1%D0%B0%D0%B7%D0%B0)

Official sites: www.k-tsl.com
www.tsl.kname.edu.ua

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: 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 Master 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, while Masters on Transport topics are already available in Ukraine and Georgia there is no specific Master

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 Masters programme. This is a major opportunity since it will allow the delivery of the Master from the second year of the project and the local needs can be captured in greater 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 system management and control.

These results have been used as inputs in the present series of deliverables whose main objective is to define the Master 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 Master 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 Master, the recommendations give many important inputs. First, there is a 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 the education and, on the other, to support research.

To improve the employment opportunities of Masters' graduates at local level 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 Master student, will be geared to research and practical activities rather than desk analysis.

O. M. Beketov National University of Urban Economy in Kharkiv - NUUE

NUUE existing curricula of Master Programmes are based on separate branches of transport systems in cities. EU educational and scientific programmes consider city transport systematically: city transport systems concern many different stakeholders, to be taken into account while developing sustainable transport systems. However, existing curricula in NUUE have not yet presented such an approach. Educational modules, based on smart technology which pay attention to the environment, have not yet been presented in the current curricula of master's programmes. There is a shortage in the application of systematic modelling tools and decision making in transport systems that are widely used in the EU and in the world.

Simultaneously, the current curricula of master's programmes in EU partner-universities include modules seeking to meet the demands of operators and users, with the aim to build competences for future city needs. They are more devoted to the management and control of the current transport services by using telematics. EU partners, which have significant experience in this field, hence help to create the methodological support, strengthen the internationalization of HEIs and the capacity to network effectively in research, scientific and technological innovation.

3 SmaLog at O. M. Beketov National University of Urban Economy in Kharkiv - NUUE

3.1 Master objectives and profile of the Master graduates

The aim of the educational programme is to acquire competencies sufficient to solve complex problems in the field of transport systems in urban areas based on best practices and technologies developed in European countries in the field of intelligent urban transport and logistics.

3.2 Master Curriculum

Based on results of user needs analysis and on discussions with Ukrainian local experts and stakeholders, Standard of the Speciality, a set of competencies for technical SmaLog professionals, has been identified. These competencies are intended to provide a broad framework for educating SmaLog professionals. They represent a fundamental set of knowledge, skills and abilities needed to effectively function as a professional in smart transport and logistics for cities.

I. Graduates will have the *General competences* (GC) defined by the *Standard of Specialty*:
GC-1. Ability to start, develop and implement individually or in a domestic (international) group projects to improve production processes in transport.
GC -2. Ability to organize work of the team, as well as motivate and manage its work.
GC-3. Ability to search, process and analyse information from various sources using modern information and communication technologies.
GC-4. Ability to determine economic indicators and ensure quality of work in developing and implementing complex actions and projects in compliance with working conditions, provisions of civil protection and environmental protection.
GC-5. Ability to communicate with professional and general audiences, present information in oral, printed or other form in native and foreign languages at a professional level.
GC-6. Ability to use in practice various theories in the field of teaching, effectively applying basic pedagogical concepts.
GC-7. Ability to conduct research within a narrow specialization, identify problems, set tasks and solve them using appropriate research methods.

II. Graduates will have the *Professional competences* (PC) defined by the *Standard of Specialty*:

GC-1. Ability to study and manage the operation of integrated transport systems.

GC-2. Ability to identify and apply perspective areas of modelling transport processes.

GC-3. Ability to use modern freight forwarding technologies.

GC-4. Ability to conduct project analysis for innovation and investment projects.

GC-5. Ability to manage supply chains and logistics centres.

GC-6. Ability to manage freight traffic by transport mode.

GC-7. Ability to manage passenger traffic by transport mode.

GC-8. Ability to study and control the movement of vehicles (vessels).

GC-9. Ability to manage the reliability and efficiency of transport technologies by transport mode.

GC-10. Ability to conduct an examination of accidents by transport mode.

GC-11. Ability to use modern methods of navigation in transport technologies by transport mode.

GC-12. Ability to take into account the impact of customs features in the formation of transport technologies.

III. Graduates will have the *Professional competences* (PC) defined by the *university*:

PCU-13. Ability to analyse the activities of the logistics system in the main areas and identify existing problems, develop measures to overcome them.

PCU -14. Ability to assess the effectiveness of traffic flows in cities and measures to organize traffic. Ability to research and design transport infrastructure facilities.

PCU -15. Ability to manage urban and regional supply chains and logistics systems using econometric models and methods, taking into account the effects of the external environment on the possibility of outsourcing.

PCU -16. Ability to form logistics systems at the macro-, meso- and micro-levels with the study of assessing the impact of the interaction of material and financial flows on the efficiency of their operation.

PCU -17. Ability to assess the effectiveness of the logistics system, taking into account inventory management strategies.

3.3 Programme structure

3.3.1 Basic concepts of smart transport and logistics for cities

The Educational and Scientific programme "Smart Transport and Logistics for cities" corresponds to:

- The National Qualifications Framework – Level 8;
- The Framework for Qualifications for the European Higher Education Area FQ-EHEA – Second cycle;
- The European Qualifications Framework for lifelong learning in the EQF-LLL – Level 7.

The Master programme lasts 1 year 9 months for 120 ECTS consisting of (Table 1):

- 10 ECTS for modules that characterise general competence;
- 48 ETCS for modules that characterise professional and practical training;
- 32 ECTS for elective professional modules (students' free choice);
- 6 ECTS for Specialised pre-diploma Training;
- 24 ECTS for Master thesis.

The Master programme includes modules of professional and practical, social and humanitarian, fundamental, natural science and general economic training, which are of an integrative nature, the content orientation of special courses and subjects of free choice of students. Professional modules are organized in four main study areas of transport:

- *passenger transportation*: methods and models for supporting the assessment and implementation of new actions for the improvement of urban passenger transport;
- *freight transportation*: methods and models for supporting the assessment and the implementation of new actions for the improvement of urban freight transport;
- *traffic*: methods and models for simulating city traffic and related impacts;
- *smart*: how telematics can drive and support improving city sustainability and liveability.

The elective professional modules can be chosen only according to batches (Professional Disciplines 1 and 2).

Table 1 – Curriculum developed at NUUE

	Module	Distribution by semester						Credits ECTS	Number of hours						Distribution of hours per week by year and semester																Distribution of classroom hours per week by semester				Department
				Course						class (auditory)						I year				II year										I year			II year	
										including:						semester														semestres				
																1				2				3				4							
																number of weeks in the semester														number of weeks in the semester				
																17				17				17				17				17	17	17	
		exam	tests	project	work	Control work	graphically calculated work		Total	total	lecture	practice	laboratory	individual work	Lc	Pr	Lab	Ind	Lc	Pr	Lab	Ind	Lc	Pr	Lab	Ind	Lc	Pr	Lab	Ind	1	2	3	4	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	
1. COMPULSORY PART																																			
1.1. General training cycle																																			
1.1.1	Scientific Research Methodology		1d					3	90	34	17	17		56	17	17		56													2				405
1.1.2	Scientific and Business Foreign Language		1d					4	120	34		34		86		34		86													2				606
1.1.3	Occupational Safety in the Field and Civil Protection		2					3	90	34	17	17		56					17	17		56										2			305
	Total		**3**					**10.0**	**300**	**102**	**34**	**68**		**198**	**17**	**51**		**142**	**17**	**17**		**56**									**4**	**2**			
1.2. Disciplines of professional and practical training																																			
1.2.1	Smart Transport and Logistics for Cities	1						5	150	68	34	34		82	34	34		82													4				605
1.2.2	City Passenger Transport	1					1	4	120	51	17	34		69	17	34		69													3				605
1.2.3	Efficiency of Cities Transport Systems	2					2	5	150	68	34	34		82					34	34		82										4			605

	Module	Distribution by semester						Credits ECTS	Number of hours						Distribution of hours per week by year and semester														Distribution of classroom hours per week by semester				Department
		exam	tests	Course: project	Course: work	Control work	graphically calculated work		Total	class (auditory): total	including: lecture	including: practice	including: laboratory	individual work	I year								II year								I year		II year		
															semester								semester								semestres				
															1				2				3				4				1	2	3	4	
															number of weeks in the semester																number of weeks in the semester				
															17				17				17				17				17	17	17		
															Lc	Pr	Lab	Ind	Lc	Pr	Lab	Ind	Lc	Pr	Lab	Ind	Lc	Pr	Lab	Ind	1	2	3	4	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	
1.2.4	Integrated Transport System in City Logistics	1					1	6	180	68	34	34		112	34	34		112													4				605
1.2.5	Traffic Control	1					1	5	150	51	17	34		99	17	34		99													3				605
1.2.6	Course project "Smart Transport and Logistics for Cities"			1				3	90					90				90																	605
1.2.7	Traffic Flows Simulating and Management	3						6	180	68	34	34		112									34	34		112							4		605
1.2.8	Freight Transportation Simulation	3						6	180	68	34	34		112									34	34		112							4		605
1.2.9	Passenger Transport Systems Simulation	3						5	150	68	34	34		82									34	34		82							4		605
1.2.10	Course project "Transport System Simulation"			3				3	90					90												90									605
1.2.11	Specialised Pre-diploma Training		4d					6	180					180																180					605
1.2.12	Master Thesis							24	720					720																720					605

	Module	Distribution by semester						Credits ECTS	Number of hours						Distribution of hours per week by year and semester																Distribution of classroom hours per week by semester				Department
		exam	tests	Course project	Course work	Control work	graphically calculated work		Total	class (auditory) total	including: lecture	including: practice	including: laboratory	individual work	I year								II year								I year		II year		
															semester																semestres				
															1				2				3				4				1	2	3	4	
															number of weeks in the semester																number of weeks in the semester				
															17				17				17				17				17	17	17		
															Lc	Pr	Lab	Ind	Lc	Pr	Lab	Ind	Lc	Pr	Lab	Ind	Lc	Pr	Lab	Ind	1	2	3	4	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	
	Total	**8**	**1**	**2**			**4**	**78.0**	**2340**	**510**	**238**	**272**		**1830**	**102**	**136**		**452**	**34**	**34**		**82**	**102**	**102**		**396**				**900**	**14**	**4**	**12**		
	Total for compulsory part	**8**	**4**	**2**			**4**	**88.0**	**2640**	**612**	**272**	**340**		**2028**	**119**	**187**		**594**	**51**	**51**		**138**	**102**	**102**		**396**				**900**	**18**	**6**	**12**		
	2. ELECTIVE PART																																		
	2.1. Informal specialization																																		
	2.1. Professional disciplines 1																																		
2.1.1	Smart Transport	2						5	150	51	17	34		99					17	34		99										3			605
2.1.2	Traffic Flows Management in the City Center		2d					5	150	51	17	34		99					17	34		99										3			605
2.1.3	Human and Environmental Impacts, Safety and Sustainability	2					2	5	150	51	17	34		99					17	34		99										3			605
2.1.4	Transportation Urban Planning	2						5	150	51	17	34		99					17	34		99										3			605
2.1.5	Course work "Transportation urban planning"				2			2	60					60								60													605

	Module	Distribution by semester						Credits ECTS	Number of hours						Distribution of hours per week by year and semester														Distribution of classroom hours per week by semester				Department
		exam	tests	Course project	Course work	Control work	graphically calculated work		Total	class (auditory) total	including: lecture	including: practice	including: laboratory	individual work	I year				II year										I year		II year		
															semester														semestres				
															1				2				3				4						
															number of weeks in the semester														number of weeks in the semester				
															17				17				17				17						
															Lc	Pr	Lab	Ind	Lc	Pr	Lab	Ind	Lc	Pr	Lab	Ind	Lc	Pr	Lab	Ind				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	
2.1.6	Supply Chain Management		3d					5	150	51	17	34		99									17	34		99							3		605
2.1.7	Logistics Systems Designing		3d					5	150	51	17	34		99									17	34		99							3		605
	Total 2.1	**3**	**3**		**1**		**1**	**32.0**	**960**	**306**	**102**	**204**		**654**					**68**	**136**		**456**	**34**	**68**		**198**						**12**	**6**		
	2.2. Professional disciplines 2																																		
2.1.8	Financial Flows in Logistics Systems	2						5	150	51	17	34		99																		3			605
2.1.9	Logistics Consulting		2d					5	150	51	17	34		99																		3			605
2.1.10	Urban and Regional Logistics Systems	2					2	5	150	51	17	34		99																		3			605
2.1.11	Integrated Material Flows	2						5	150	51	17	34		99																		3			605
2.1.12	Course work "Integrated material flows"				2			2	60					60								60													605
2.1.13	Theory of Stocks		3d					5	150	51	17	34		99									17	34		99							3		605
2.1.14	Logistics Process Optimisation		3d					5	150	51	17	34		99									17	34		99							3		605
	Total 2.2	**3**	**3**		**1**		**1**	**32**	**960**	**306**	**102**	**204**		**654**					68	136		456	34	68		198						**12**	**6**		
	Total for curriculum	**11**	**7**	**2**	**1**		**5**	**120.0**	**3600**	**918**	**374**	**544**		**2682**	**119**	**187**		**594**	**119**	**187**		**594**	**136**	**170**		**594**				**900**	**18**	**18**	**18**		

	Module	Distribution by semester						Credits ECTS	Number of hours						Distribution of hours per week by year and semester														Distribution of classroom hours per week by semester				Department
		exam	tests	Course: project	Course: work	Control work	graphically calculated work		Total	class (auditory): total	including: lecture	including: practice	including: laboratory	individual work	I year								II year						I year			II year	
															semester														semestres				
															1				2				3				4						
															number of weeks in the semester														number of weeks in the semester				
															17				17				17				17						
															Lc	Pr	Lab	Ind	Lc	Pr	Lab	Ind	Lc	Pr	Lab	Ind	Lc	Pr	Lab	Ind				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	
	Number of ECTS credits per semester														**30**				**30**				**30**				**30**				**30**	**30**	**30**	**30**	
	Number of tests														**4**				**4**				**3**								**4**	**4**	**3**		
	Number of exams														**2**				**2**				**2**				**1**				**2**	**2**	**2**	**1**	
	Number of course projects														**1**								**1**								**1**		**1**		
	Number of course works																		**1**													**1**			
	Number of control works																																		
	Number of graphically calculated works														**3**				**2**												**3**	**2**			

3.3.2 Educational objectives/common and special parts

The educational objective is to obtain theoretical knowledge, skills and abilities sufficient to develop new ideas, solve complex problems in the field of transport technologies, which study the laws that determine the conditions of rational organization of transport services and transport processes and cover the problems of building and ensuring efficient operation of transport components, development of its material and technical base.

The learner must satisfy the programme requirements in the programme specification, which includes:

- theoretical classroom instruction on subjects (lectures, seminars and practical studies),
- consultations and independent student work, including fulfilment of a course project and paper on speciality;
- pre-diploma training and thesis defence.

Credits are awarded based on a student's successful passing of written/oral tests and exams in subjects, defence of a course project, and defence of a report on the training, tests, practice, control tasks, seminars, defence of Master's thesis.

Level of qualification

The ability to solve complex problems and problems in the field of transport systems and technologies, which are characterized by uncertainty of conditions and requirements, involves research and innovation.

3.3.3 Learning outcomes

Defined by the Standard of Higher Education in the specialty based on general competences

LO-1. Develop, organize and implement a project on a topical issue in the field of transport technology. Divide the tasks among the performers and determine the deadlines.

LO-2. Select the necessary provisions from legislation on labour protection, civil protection and environmental protection, relating to the relevant issues of the study. Be able to apply these provisions in practice.

LO-3. Be able to self-organize and allocate their working time to perform tasks and allocate time for self-education in the professional sphere.

LO-4. Expand, supplement or modify existing scientific theories with their own ideas and achievements based on the synthesis of acquired knowledge and practical experience. Test existing scientific hypotheses.

LO-5. Collect initial data for project implementation and perform their analysis using modern information and communication tools, interpret the results. Formulate the purpose, objectives, subject and object of research.

LO-6. Criticize and analyse information sources in native and foreign languages, draw conclusions. Discuss the chosen topic using scientific categories.

LO-7. Present the results of the analysis or research in printed or other form in a foreign or native language. Translate terms, abstracts and annotations into a foreign language.

LO-8. Motivate and criticize performers, anticipate the consequences of actions and outline the expected results. Perform economic evaluation of projects, determine their direct and indirect effect.

LO-9. Be able to apply the scientific results of specialized disciplines to develop optimal conditions for the functioning of transport systems, using advanced technological rules and procedures, measurement techniques in order to obtain the results of scientific research.

LO-10. Ability to improve and develop their intellectual and cultural level, independently learn new research methods, to change the scientific and research and production profile in their professional activities.

LO-11. Be able to freely use native and foreign languages as a means of business communication.

LO-12. The ability to independently acquire and use in practice new knowledge and skills, in particular in new areas of knowledge not directly related to the field of activity.

LO-13. To be able to develop strategies of transport technologies, to define the purposes of designing, criteria of efficiency, limitations of applicability, to be able to develop new methods and means of designing of transport technologies.

LO-14. Ability to provide support of the processes of design, implementation and maintenance of information systems and transport technologies.

LO-15. Be able to find a compromise between different requirements (cost, quality, deadlines) for both long-term and short-term planning, finding optimal solutions.

LO-16. Ability to collect, analyse scientific and technical information, domestic and foreign

experience on research topics.

LO-17. Be able to develop and research theoretical and experimental models of objects of professional activity.

LO-18. Be able to form new competitive ideas in the field of theory and practice of transport technologies, to develop methods for solving non-standard problems and new methods for solving traditional problems.

Defined by the Standard of Higher Education in the specialty based on Professional competences

LOP-19. Improving approaches and methods for research and management of integrated transport systems.

LOP-20. Substantiation of expediency of measures on improvement of transport technologies with use of modelling of transport processes. Evaluate the effectiveness of selected measures.

LOP-21. To substantiate expediency of application of modern technologies of transport and forwarding services.

LOP-22. Improve approaches and methods for conducting commercial, technical, social, environmental, institutional, financial and economic analysis in the development of innovation and investment projects.

LOP-23. Analyse and justify the application of modern methods, have the ability to analyse and calculate the economic performance of the supply chain and logistics centres. Use information resources to model supply chains.

LOP-24. Develop measures for freight transportation management using modelling of freight transportation processes by transport mode.

LOP-25. Develop measures for passenger transportation management using modelling of passenger transportation processes by transport mode.

LOP-26. Analyse and substantiate the feasibility of scientific recommendations and modern methods of controlling the movement of vehicles (vessels).

LOP-27. Have the skills to study theoretical and experimental models of management of reliability and efficiency of transport technologies by transport mode.

LOP-28. Have the skills to apply modern methods of examination of traffic accidents.

LOP-29. To substantiate expediency of application of modern methods of navigation in transport technologies by types of transport.

LOP-30. To carry out development and research of influence of customs features at formation of transport technologies.

Defined by the University

LOU-31. Have the skills to assess the effectiveness of traffic flows in cities and traffic management activities. Analyse and have skills in research and design of transport infrastructure.

LOU-32. Design logistics processes in supply chains, take into account the impact of the human factor on the parameters of technological processes of transportation of goods and passengers.

LOU-33. Design, plan the budget of logistics costs and organize the implementation of management logistics solutions for their optimization while complying with the condition of ensuring the required level of quality of logistics services.

LOU-34. Develop measures for inventory management; evaluate the effectiveness of the logistics system, taking into account inventory management strategies.

3.3.4 Modules

The detailed Curriculum of the 2019/20 training supply of the Master's Degree in Transport technologies (by mode) can be consulted on: https://kis.kname.edu.ua/workPlan/speciality

The students' timetable can be found on: https://kis.kname.edu.ua/timeTable/group#

The Master programme includes the following modules, which describe the graduates in SmaLog in greater depth, Table 2.

Table 2 – Professional modules of the Master programme

Module	
Smart Transport and Logistics for Cities	Table 3
Traffic Flow Simulation 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
Smart Transport and Logistics for Cities Project	Table 10
Human and Environmental Impacts, Safety and Sustainability	Table 11
Traffic Flow Management in the City Centre	Table 12
Efficiency of City Transport Systems	Table 13

Table 3 – Synoptic table of module Smart Transport and Logistics for Cities

Title	Smart Transport and Logistics for Cities
Number of ECTS	5
Year and semester	1st year, 1st semester
Lecturer	Associate prof. Mariia Olkhova
Teaching method	innovative, verbal, visual, practical, active and control methods with the use of the best European practices of learning
Prerequisites	Existence of the first (Bachelor's) Degree or educational qualifying level of specialist
Examination procedure	theoretical part – questions (written and oral), practical part – exercises
Project foreseen	Individual course project
Aim	The *aim* of the module "Smart Transport and Logistics for Cities" is to obtain the theoretical and practical bases of city logistics and smart transport technologies based on the best European practices and current methods of transport management in the city. The *main objectives* of the module "Smart Transport and Logistics for Cities" are to study of the mechanism of solving transport problems in the city, tools for improving the efficiency of urban logistics and transport within the city. The acquired theoretical and practical knowledge during the study of the module will provide the necessary skills and competencies for analysing city transport systems, paying special attention to smart technologies, providing tools for solving problems, assessing the existing transport system and city logistics, alternatives and their impact. *Outcomes* of the module is to acquire the following competencies by students: *students must know:* - approaches and methods for studying and managing the operation of transport systems for freight and passengers in the city; - measures to improve transport technologies using modelling of transport processes in cities; - methods of analysis of city transport and assessment of the effectiveness of systems; - approaches of the application of information communication technologies and smart transport systems in the city transport system. *students must be able to:* - assess the existing transport system and city logistics, alternatives and their impact; - to investigate and manage the operation of transport systems for the freight and passengers in the city; - to improve transport technologies using of modelling of transport processes; to evaluate the effectiveness of the selected activities; - apply of information communication technologies and smart transport systems in the city transport system. *students must have the competence***:** - ability to apply the acquired knowledge based on the application of techniques - analysis of city transport systems, in particular using smart transport systems and information communication technologies. - research and management of the operation of integrated transport systems; - management of freight, passenger transportation, traffic control within the city; - implementation of information communication technologies and intelligent transport systems in the city transport system.
Contents	*Module 1 content: Transport Systems in Urban Infrastructure s* 1. Stakeholder analysis and the role of the public sector. Differences between types of urban area. Road congestion. Conflict between UFT and pedestrians. Environmental pollution. Economic efficiency in urban distribution. 2. 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. 3. 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. *Module 2 content: Theory of Transport Systems* 4. Transport System in an ITS Context. Network models and their use in transport. Static simulation of transport network. Traffic flow theory. Demand models. 5. Evaluation and Comparison of Transportation System Projects. Relevant Impact. Measures of effectiveness. Evaluation tools (CBA, CEA, MCA). Monitoring of the transport system. Environmental Impact Assessment (EIA) and Strategic Impact Assessment (SEA). Road safety Impact Assessment (RIA) *Module 3 content: Trends in Smart Transport and Logistics* 6. 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. 7. City logistics and applications. Introduction to the concept of city logistics as a solution to urban freight problems, applications to different urban context in Europe and beyond, methods and examples. 8. ITS in urban freight transport and traffic.
Text book	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. 6. Taniguchi E., Russell G. Thompson (2015), City logistics: mapping the future. CRC Press, Nov 21, 2014 - Business & Economics - 231 pages. Notes by the lecturer
Support tools	MS Office (Excel, Word, PowerPoint, Visio)

Table 4 – Synoptic table of Traffic Flow Simulation and Management module

Title	Traffic Flow Simulation and Management
Number of ECTS	6
Year and semester	2nd year, 3rd semester
Lecturer	Associate prof. Dmytro Burko
Teaching method	innovative, verbal, visual, practical, active and control methods with the use of the best European practices of learning
Prerequisites	Existence of the first (Bachelor's) Degree or educational qualifying level of specialist
Examination procedure	theoretical part – questions (written and oral), practical part – exercises

Project foreseen	Course project is not foreseen
Aim	The *aim* of the module "Traffic Flow Simulation and Management" is to obtain the theoretical and practical bases of traffic flow simulation and management based on the best European practices and current methods. The *main objective* of the module "Traffic Flow Simulation and Management" is 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. The acquired theoretical and practical knowledge during the study of the module will provide the necessary skills and competencies for analysing trends in traffic flow simulation, traffic impact assessment and traffic flow management in cities. *Outcomes* of the module are that students acquire the following competencies by students: *students must know:* - modern approaches and methods of traffic flow simulation; - the theoretical basis for assessing the impact of traffic flows on the efficiency of the transport network and traffic safety; - approaches and methods for managing traffic flows in cities. *students must be able to:* - apply the main approaches to the simulation of traffic flows and the assessment of traffic conditions in practice; - determine the main indicators for ensuring the safety of traffic flow; - determine the values of criteria for evaluating the effectiveness and safety of the functioning of transport networks - put into practice a suitable traffic management system in cities. *students must have the following competence*: - to use modern methods of management and simulation of traffic flows; - to improve ways to assess the impact of traffic flows on the efficiency and safety of transport networks; - organize safe and efficient traffic flow in cities; - manage traffic in cities using different control systems.
Contents	*Module 1 content: Traffic Flow Simulation* 1. General approaches to traffic flow simulation The purpose and tasks of transport flow simulation. Requirements for traffic flow models. Characteristics, advantages and disadvantages of existing approaches to traffic flow simulation (macro simulation and micro- simulation). 2. Basic thesis of the theory of traffic flows. Variables that characterize the intensity, velocity and density of traffic flows. Spatial-time charts of the movement of groups of cars on road sections. Basic equation and main flow chart. Dependence between speed and density of traffic flows (Linear Greenshield model). The relationship between the intensity and density of traffic flows. The relation between speed and intensity of traffic flows. *Module 2 content: Assessment of Traffic Impacts* 3. Assessment of traffic conditions. Capacity of city streets and roads. Factors that determine the conditions of the movement. Levels of service and their boundary characteristics. Existing approaches to estimating traffic conditions on city streets and roads (estimation of the specific gravity of traffic delays, average speed estimation). Regularities of changing intensity, speed, density of traffic on city streets and roads. 4. Safety of movement of traffic flows. Absolute rates of accidents. Relative accident rates. Indicators of the severity of the consequences of an accident. Current state of accidents in the countries of the world. Methods of conflict assessment. (Crossing difficulty assessment, intersection hazard assessment). Methods of estimating the impact of road conditions on traffic safety (method

	of total accident rate coefficients, method of safety coefficients). 5. Criteria for assessing the efficiency of transport networks. Method of calculation of indicators of efficiency of transport network functioning. Average speed on the transport network. Total travel time costs. Average time of one trip on the transport network, the total mileage of all vehicles on the network Average distance of one trip. The specific weight of movement on the public transport. Average loading level of traffic network. 6. Criteria for assessing the safety of the functioning of transport networks. Methodology for calculating safety indicators for the functioning of transport networks. The number of deaths in an accident, the number of injured, the number of accidents. Assessment of material damage from an accident. Assessment of material damage from air pollution by harmful substances of exhaust gases of cars. Estimation of material losses from CO2 emissions. *Module 3 content: Traffic Flow Management in Cities* 7. Classification of traffic management systems in cities. Distribution of traffic flows in time: control of traffic light signals. Distribution of traffic flows in space by channelling traffic. Formation of homogeneous traffic flows. Ensuring the priority of public. Optimization of high-speed traffic flow mode. Recommendations and appointment of traffic routes. Reversing lanes. Optimizing of parking network. Organization of one-way traffic. Highway control systems. Network management of traffic flows. 8. Highway control systems. Traffic control with pre-signals and speed indicators. Network management. Speed control. Constraints and speed control. Adjustment of entry to the highway.
Text book	1. Slinn M., Matthews P., Guest P. Traffic Engineering Design Principles and Practice. Second edition. — Elsevier Butterworth-Heinemann, 2005. 241 p. 2. Manual for the design of road traffic facilities: HBS 2015 / FGSV; Part A: Highways 3. Urban Transportation and Logistics: Health, Safety, and Security Concerns 4. Vukan R. Vuchic Transportation for Livable Cities 5. TOWARDS ZERO Ambitious Road Safety Targets and the Safe System Approach 6. Cascetta, E. (2009). Transportation Systems Analysis: Models and Applications. Springer. Notes by the lecturer
Support tools	MS Office (Excel, Word, PowerPoint, Visio), PTV Visum, CITILOG X-Cam P

Table 5 – Synoptic table of Traffic Control module.

Title	Traffic Control
Number of ECTS	5
Year and semester	1st year, 1st semester
Lecturer	Associate prof. OleksiiPrasolenko
Teaching method	innovative, verbal, visual, practical, active and control methods with the use of the best European practices of learning
Prerequisites	Existence of the first (Bachelor's) Degree or educational qualifying level of specialist
Examination procedure	theoretical part – questions (written and oral), practical part – exercises
Project foreseen	
Aim	Objectives. 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.

	students must know: – characteristics of the road and modern methods for their study; – modern methods of traffic management at intersections and roads; – patterns of change in the parameters of traffic flow; – modern approaches to traffic management at intersections and roads; – methods for assessing the effectiveness and safety of traffic and pedestrian traffic. *students must be able to:* – investigate the parameters of traffic and pedestrian flows; – to use modern methods of traffic management at intersections and roads; – perform modelling of traffic flows, pedestrian flows; – develop measures to improve road safety at intersections and roads; – determine the effectiveness of the implementation of measures to improve road safety at intersections and roads. *students must have the competence*: – analysis of the characteristics of the road; – justify the use of traffic management techniques at intersections and roads, suggest practical measures; – to investigate the parameters of traffic flow; – implement modern approaches to traffic management at intersections and roads; – to assess the effectiveness of the implementation of measures to improve road safety at intersections and roads.
Contents	*Module 1 content: General methodological provisions for traffic control* 1. System approach in traffic management. Definition of the concept of "road traffic". System "car - driver - road environment". Formation of a traffic flow. The structure and connections of the system "Road Conditions - Transport flows". Management of the system "Road conditions - Transport flows". Information as the basis of such management. 2. Transport flow. Intensity of the movement, concept, units of measurement. Composition of the 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 main 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. 3. Throughput. Throughput of the lane of traffic, plot of movement, intersection. Spatial, temporal and probabilistic nature of the throughput. Loading level, traffic conditions and traffic flow status. 4. Transport studies and traffic forecasting. Task and classification of transport research. Methods research of characteristics of traffic flow. Study of pedestrian and bicycle traffic. Processing of the results of the study. Forecasting data, forecasting methods, accuracy of forecasting. *Module 2 content: Traffic control with street and road interchanges* 5. 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. 6. 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. *Module 3 content: Practical aspects of traffic management* 7. 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 network of cities and traffic delays on them. 8. Road traffic control methods and measures. Basic methods of traffic management. Segregation of the traffic flow by composition. Homogeneity of the 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 traffic of vehicles. Pedestrian zones: classification, size, arrangement, negative effects. 9. Assessment of road safety. 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 data on road accidents. Costs from road accidents. The main measures for changing the number of road accidents. Forecasting a reduction in the number of road accidents after the implementation of measures to improve traffic management.
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., ЗнанняУкраїни, 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 Notes by the lecturer
Support tools	MS Office (Excel, Word, PowerPoint, Visio)

Table 6– Synoptic table of the City Passenger Transport module

Title	City Passenger Transport
Number of ECTS	4
Year and semester	1st year, 1st semester
Lecturer	Associate prof. Denys Ponkratov
Teaching method	innovative, verbal, visual, practical, active and control methods with the use of the best European practices of learning
Prerequisites	Existence of the first (Bachelor's) Degree or educational qualifying level of specialist
Examination procedure	theoretical part – questions (written and oral), practical part – exercises
Aim	The *aim* of the module "City passenger transport" is to obtain the theoretical and practical bases on methods and tools of public transit systems design, operation and management transportation based on the advanced smart transport technologies. The *main objectives* of the module "City passenger transport" are to study of the mechanism of solving

	public transit operation problems, principles of the tools and equipment usage for solving tasks of the transit systems design, operation and management. The acquired theoretical and practical knowledge during the study of the module will provide the necessary skills and competencies for current transit service analysis, developing alternative measures for its improvement, operation and transportation management on the basis of smart transport technologies usage; to provide comparative estimation of efficiency of alternative variants of design decisions and to choose the most expedient with application of advanced tools of transport modelling; to carry out scientific research of actual problems arising from city passenger transport. *Outcome* of the module is that students acquire the following competencies: *students must know***:** - principles and requirements for city route systems planning; - approaches and methods of transit network design; - the essence, principles and structure of the passenger path choice models; - classification of assignment models for transit networks; the essence, conditions and areas of using existing methodological approaches; - structure of tasks, principles and methods of operation and transportation process management on transit routes; - the essence of advanced methods of information support and control of transportation services; - conditions of application, requirements for design and technology of rapid transit operations; - the tasks, normative requirements and the essence of methodical approaches to transit quality of service estimation; - the tasks, factors and the essence of methodical approaches to value travel time and passenger fatigue estimation. *students must be able to:* - by analysing the existing situation, to choose the strategic directions of city passenger transport development based on transit-oriented methods; - to perform input data formation, to adjust models and to conduct programme-based evaluation of the transit network parameters; - to choose rational route service technological parameters by analysing relevant efficiency criteria; - to analyse the effect of smart transport technology applications on service parameters; - to determine the conditions of application expediency and parameters of rapid transit operation; - to identify the factors and conditions of unsatisfactory transit services; - to conduct research of the value of travel time and passenger fatigue estimation; - on the basis of a critical analysis, identify the problematic aspects of the city passenger transport operation and, through creative thinking, pave the way for their solution. *students must have the following competencies:* - strategic planning of the city transport systems development based on transit-oriented methods; - creation of transit network models by using the relevant software in order to develop measures for their improvement; - solving the tasks of transit service operation and management based on demand estimation; - application of advanced smart transport technologies for the purpose of information provision, monitoring and transit service operational management; - analyse the consequences of applying efficiency indicators on the rapid transit system; - provide the transit quality of service estimation and determine the means for its increase; - apply the value of travel time and passenger fatigue estimation results in the tasks of transport modelling and transportation management;

	- set up a problem task in the field of city passenger transport and identify ways to overcome it based on transport modelling techniques.
Contents	*Content of module 1: Routing system simulation* 1. Transit planning Transit-oriented development methods. Transit network planning tasks. Transit demand forecasting method. Transit supply models. Public transport networks and its parameters. 2. Models for the analysis and the design of urban passenger transport systems. Transit network routing problem. General methodology for designing public transport routes. Transit network design objective functions. Graph approach for transit network representation. Methods of estimation of origin-destination matrices in transit networks. Models for transit network design. 3. Passenger path choice models. Discrete choice models and its application to route choice behaviour. Decision-maker characteristics and attributes of alternatives. Defining alternatives and choice set generation. Random utility-based discrete choice models for travel demand analysis. Estimation of discrete choice models. Specification of discrete choice models for transit path choice application. 4. Assignment models for transit networks. Classification of assignment models. General scheme of transit assignment models. Fields of application of assignment models. Frequency-based models. Schedule-based models. Congested public transport assignment. Dynamic process assignment. *Content of module 2: Passenger transportation management* 5. Route operation management. Reorganization and management of local public transport services. Choice of frequency and vehicle size. Fleet size required for a single route determination. Technological parameter choice objective functions. Constraints on technological parameters. Models for technology choice in a transit route. Vehicles and crew scheduling methods. 6. Intelligent transportation systems on public transit. Advanced information and control methods. Intelligent transport real-time information systems. Providing monitoring systems. Fare collection systems. Traveller behavioural models for Intelligent transport systems. Design supervision of automatic vehicle monitoring system of bus fleets. Definition of methods for supporting travellers moving on stochastic multi service network 7. Rapid transit Trends in transit ridership and in use of different modes. The demand performance. Priority treatments on city streets. Stop location. Bus Rapid Transit. Light rail transit. *Content of module 3: Human factor in passenger transportation* 8. Transit quality of service estimation. Quality standards for public transport service. Measuring comfort in public transport. Analysis of transit user preferences. Discomfort in mass transit and its implication for scheduling and pricing. Valuing crowding in public transport systems: objective and subjective measures. Congestion cost in mass transit systems. 9. Value of travel time and fatigue estimation. Value of travel time estimation methods. Human effort and the value of travel time. Travel fatigue factors. Travel fatigue estimation methods. Application value of travel time and fatigue estimation for transit modelling and operating.
Text book	*Main* 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. Ceder, A. (2007). Public transit planning and operation: Modeling, practice and behavior. CRC press. 5. Lam, W. H., Bell, M. G. (Eds.). (2002). Advanced modeling for transit operations and service planning. Emerald Group Publishing Limited. 6. Vuchic, V. R. (2007). Urban transit systems and technology. John Wiley & Sons. 7. Sładkowski, A., Pamuła, W. (Eds.). (2016). Intelligent transportation systems-problems and perspectives (Vol. 303). Springer International Publishing. 8. Gentile, G., &Noekel, K. (2016). Modelling public transport passenger flows in the era of intelligent transport systems. Gewerbestrasse: Springer International Publishing. 9. Доля, В. К. (2011). Пасажирськіперевезення. Х.: Вид-во «Форт». *Additional* 1. Nielsen, G., Nelson, J. D., & Mulley, C. (2005). Public transport: planning the networks. HiTrans. 2. KFH Group. (2013). Transit capacity and quality of service manual 3. McDonald, M., Keller, H., Klijnhout, J., Mauro, V., Hall, R., Spence, A., ... &Fakler, O. (2006). Intelligent Transport Systems in Europe: opportunities for future research. 4. Grava, S. (2003). Urban transportation systems. Choices for communities. Notes by the lecturer
Support tools	MS Office (Excel, Word, PowerPoint, Visio); PTV VISUM

Table 7 – Synoptic table of Freight Transportation Simulation module.

Title	Freight Transportation Simulation
Number of ECTS	6
Year and semester	2nd year, 1st semester
Lecturer	Associate prof. Yevhen Kush
Teaching method	Innovative, verbal, visual, practical, active and control methods with the use of the best European practices of learning
Prerequisites	Existence of the first (Bachelor's) Degree or educational qualifying level of specialist
Examination procedure	Theoretical part – questions (written and oral), practical part – exercises
Project foreseen	-
Aim	The *aim* of the module "Freight Transportation Simulation" is to obtain the methodological, theoretical and applied basic contents of planning and operative management of freight transport systems and logistics. Teaching will provide the student 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. Substantiation of feasibility of measures for improvement of transport process through with the use of simulation tools (methods and models). Capacity to identify and analyse 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. *Outcome* of the module is that students acquire the following competencies: *learning outcomes for special (Professional, subject) competency:* - substantiate the measures to improve transport technology using simulation of transport processes. Perform an assessment of the effectiveness of selected events; - analyse and justification of applying modern techniques, have the ability to carry out analysis and calculation of the economic indicators of the chain of supply and logistics centres. Use information resources for carrying out the simulation of supply chains; - develop measures for the management of cargo transportations with the use of

	modelling of processes of transportations of cargoes by transport mode. *students must have the competence***:** - the ability to identify and use perspective directions of modelling of transport processes - the ability to supply chain management and logistics centres. - the ability to control cargo transportation by transport mode.
Contents	*Content of module 1: Freight transportation* 1. Logistics and supply chain. The supply chain: structure and functionalities of a logistics network, Problem classifications, Distribution strategies. 2. Freight transportation. Freight mode and transport costs. Logistic costs and mode choice. 3. Freight nodes. Definition, classification and functions of freight node. *Content of module 2: Demand forecasting* 4. Transport data Analysis and freight demand models. Ports within the supply chains and the revolution of container. 5. Multi Regional Input Output models. Estimation of Origin - Destination matrices. 6. Modal split. Aggregate / disaggregate models consignment and logistics models. *Content of module 3: Assessing freight scenarios* 7. Design of freight nodes. Effect classification. Financial analysis, Benefit-Cost Analysis, Multi-Criteria analysis. Technical-Economic feasibility studies. 8. Freight transport planning. Examples of freight plans.
Text book	1. G. Ghiani, G. Laporte, R. Musmanno. Introduction to Logistics Systems Planning and Control. J. Wiley & Sons, 2004. 2. Daganzo, C. F. (1991). Logistics Systems Analysis. Springer-Verlag. 3. Tavasszy, L. and De Jong, J. (eds; 2014), Modelling Freight Transport, Elsevier, ISBN: 978-0-12-410400-6, 2014. 4. Ben Akiva, M., Hilde Meersman and Eddy Van de Voorde (eds.; 2013), Freight Transport Modelling, Emerald Group Publishing Limited. 5. Rodrigue, J.P. (2013). The Geography of Transportation Systems. Routledge - Taylor & Francis Group. 6. 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.). 7. Nuzzolo, A., Crisalli, U. and Comi, A. (2015). An aggregate transport demand model for import and export flow simulation. In Transport 30 (1) 8. 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 AngeliEditore, Milan, chapter 14, 210 – 224. 9. Cascetta, E. (2009). Transportation Systems Analysis: Models and Applications. 2nd edition. Springer. 760 p. 10. Ennio CascettaVittorioMarzanoVittorioMarzanoAndreaPapolaAndreaPapolaRoberta Vitillo (2013). A Multimodal Elastic Trade Coefficients MRIO Model for Freight Demand in Europe. 11. Nuzzolo and Russo (1995). A disaggregate freight modal choice model. In Proceedings of 7 WCTR, Sydney. 12. 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. Notes by the lecturer
Support tools	MS Office (Excel, Word, PowerPoint, Visio)

Table 8 - Synoptic table of the Smart Transport module

Title	Smart Transport
Number of ECTS	5
Year and semester	1st year, 2nd semester
Lecturer	Associate prof. Oleksii Prasolenko
Teaching method	innovative, verbal, visual, practical, active and control methods with the use of the best European practices of learning
Prerequisites	Existence of the first (Bachelor's) Degree or educational qualifying level of specialist
Examination procedure	theoretical part – questions (written and oral), practical part – exercises
Project foreseen	
Aim	Objectives. 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. *Outcomes* of the module is to acquire the following competencies by students: *students must know:* – methods of modelling traffic, density and speed of movement; – characteristics of intellectual systems of road safety, their purpose, their functionality and the impact on road safety; – Global Navigation Satellite Systems. Positioning and technicalities fundamentals; – Mobile Mapping Systems (MMS). Accuracy and applications of MMS. Components of a MMS and sensors. Principles of sensors integration. *students must be able to:* –practice the methods of modelling traffic, investigate the density and speed of traffic flow; –use the capabilities of intelligent road safety systems, suggest methods for improving road safety; – apply global navigation satellite systems to transport; – apply mobile mapping systems (MMS). Take into account the accuracy of MMS. *students must have the competence***:** – to analyse the characteristics of traffic using the methods of traffic modelling, to predict the speed of traffic flow; – to explore the results of the application of intelligent traffic safety systems. Perform an assessment of the application of intelligent systems; – to form effective routes of movement using global navigation satellite systems in transport; – to implement mobile mapping systems (MMS).
Contents	*Content of module 1: Information Technologies in Traffic Management* 1. 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 registration of vehicles on the road. Video monitoring of traffic. Traffic management centres. 2. Road traffic control. Road traffic speed control systems , 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.

	3. Control and guidance for drivers. Road signs, road surface markings, information to drivers and pedestrians. Online information to car park usage, pedestrian crossing usage, areas of low and high congestion, frequency, location and cause of road works. 4. Network and traffic management systems. ITS for the road network. Monitoring methods and technologies. Urban traffic management. *Content of module 2: Intelligent traffic safety systems* 5. 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. 6. Active safety of vehicles. Anti-lock braking system, electronic stability control, chassis assist, intelligent speed adaptation, brake assist, traction control, collision avoidance warning, adaptive or autonomous cruise control system. 7. Passive safety of vehicles. Passenger safety cell, deformation zones, seat belts, load space barrier-nets, air-bags, laminated glass, correctly positioned fuel tanks, fuel pump kill switches. Crash test car. 8. 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. *Content of module 3: Satellite Navigation Systems in the Transport* 9. Classification of satellite navigation systems. Civil and military uses. Global satellite navigation systems (GPS, GLONASS, Galileo, BeiDou-2). Regional satellite navigation systems (BeiDou-1, NAVIC, QZSS). 10. Principles of satellite navigation systems operation. Basic elements of satellite navigation. Principles of workings. Coordinate system. The system of time. Navigation radio signals. Navigational navigation. Factors that affect the accuracy of positioning. Means for increasing the accuracy of positioning. Monitoring of vehicle traffic parameters by satellite navigation. 11. 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 transport operations using navigation systems. Selection of traffic routes. Simulation of transport parameters by means of satellite navigation systems. Mobile Mapping Systems.
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., ЗнанняУкраїни, 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 Notes by the lecturer 10. A. El-Rabbany – Introduction to GPS – Artech House 11. R. Galati – Geographical Information System Demystified – Artech House

	12. P. Fu, J. Sun - Web GIS: Principles and Applications – ESRI 13. C. V. Tao and J. Li – Advances in Mobile Mapping Technology – ISPRS Book Series – ISPRS
Support tools	MS Office (Excel, Word, PowerPoint, Visio),

Table 9 – Synoptic table of the Integrated Transport Systems in City Logistics module

Title	Integrated Transport Systems in City Logistics
Number of ECTS	6
Year and semester	1st year, 1st semester
Lecturer	Associate prof. Alexander Rossolov
Teaching method	innovative, verbal, visual, practical, active and control methods, stimulation and motivation of educational-cognitive activity
Prerequisites	Existence of the first (Bachelor's) Degree or educational qualifying level of specialist
Examination procedure	theoretical part – 2 questions (written and oral), practical part – 1 exercise
Project foreseen	-
Aim	The *aim* of the discipline "Integrated Transport Systems in City Logistics" is to obtain the knowledge and skills regarding the analysis of urban freight transport and city logistics management based on the European practices and current methods of transport management in the city. The *main objective* of the module "Integrated Transport Systems in City Logistics" is to research and manage city logistics. *Outcome* of the module is that the students acquire the following competencies: *students must know:* - infrastructure problems, Goods transportation and traffic problems; - the scope of the warehousing problem in the city area, Rational location determination; - characteristics of the goods transportation actors, definition of utility function, transport service and modal choice utility functions; - definition of methods for revealing shopping mobility activities; - definition of methods for revealing freight distribution mobility activities; - the urban goods movement in city transit, constraints to urban goods movement; - general statement of city freight transportation routing, iterated nearest insertion algorithm; - identification of relevant impacts, identification and estimation of impact indicators; - material infrastructure measures, non-material infrastructure measures, equipment measures, governance measures; - city logistics planning objectives, formulation and ex-ante assessment of alternative planning scenario, direct effect target and outcome indicators. *students must be able to:* - assess integrated transport system functioning; - define and calculate the basic parameters of in-store and internet purchasing; - do calculations using MNL models; - form the scenarios of the integrated transport system function in case of the city territory; - run the simulation of the network total travel time and road traffic for the city. *students must have the competence***:** to apply the acquired knowledge based on the application of techniques - to manage freight traffic by modes of transport; - to identify and apply promising directions for modelling transport processes; - to manage the reliability and efficiency of transport technologies by type of

	transport.
Contents	*Content of module 1: Principles of urban goods movements* 1. Urban freight distribution and shopping mobility: actors and problems. Infrastructure problems, Goods transportation and traffic problems, Delivery periods, Urban freight transport sustainability, General typology of last-mile deliveries. 2. E-commerce. Trends, performance, infrastructures and delivery structure. 3. Distribution centres and warehouses. The scope of the warehousing problem in city areas, Rational location determination, Location scenarios for transport modes, City transit impacts. *Content of module 2: Urban goods modelling* 4. Identification of actors and choice dimensions. Characteristics of goods transportation actors, Definition of utility function, Transport service and modal choice utility functions, Probability of mode choice. 5. Shopping mobility: surveys. Definition of methods for revealing shopping mobility activities. 6. Freight distribution: surveys. Definition of methods for revealing freight distribution mobility activities. 7. Urban goods movements: integrated modelling. Urban goods movement in city transit, Constraints to urban goods movement. 8. Routing and schedule models. General statement of city freight transportation routing, Iterated Nearest Insertion Algorithm, Genetic Algorithm, Vehicle routing and scheduling problem with time windows. *Content of module 3: City logistics scenario assessment* 9. 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. 10. City logistics measures. Urban goods movements and relevant actors, Material infrastructure measures, Immaterial infrastructure measures, Equipment measures, Governance measures. 11. Freight distribution: surveys. City logistics planning objectives, Formulation and ex-ante assessment of alternative planning scenario, Direct effect target and outcome indicators.
Text book	1. Taniguchi, E. Urban Transportation and Logistics: Health, Safety, and Security Concerns / E. Taniguchi, T. Fang Fwa, R. G. Thompson. – I Edition. CRC Press, 2013. – 280 p. 2. Macharis, C. City distribution and Urban freight transport: Multiple perspectives / M. Cathy, S. Melo. - Edward Elgar Publishing, 2011. – 260 p. 3. Charu, C., JānisG. Supply Chain Configuration: Concepts, Solutions, and Applications / C.Charu, G.Jānis. – Springer, 2016. – 293 p. 4. Gonzalez-Feliu, J. Models and methods for the City Logistics: The Two-Echelon Capacitated Vehicle Routing Problem. Politecnico di Torino, 2008. 148 p. 5. Comi, A., Nuzzolo, A., 2016. Exploring the relationships between e-shopping attitudes and urban freight transport. Transportation Research Procedia, 12, 399–412. 6. Nuzzolo, A., Crisalli U., Comi A. A demand model for international freight transport by road // European Transport Research Review. 2008. Vol. 1, Issue 1. P. 23–33. 7. Nuzzolo, A., Coppola P., Comi A. Freight transport modeling: Review and future challenges // International Journal of Transport Economics. 2013. Vol. XL, Issue 2. P. 151–181. 8. Cascetta, E., 2009. Transportation Systems Analysis – Models and Applications, Springer US, 2nd Edition, 742 p. 9. de Dios Ortúzar, J., Willumsen, L. G., 2011. Modelling Transport, John Wiley & Sons, Ltd, 4th edition, 607 p. Notes by the lecturer

Support tools	MS Office (Excel, Word, PowerPoint, Visio), PTV Visum

Table 10 – Synoptic table of the Smart Transport and Logistics for Cities Project module

Title	Smart Transport and Logistics for Cities Project
Number of ECTS	3
Year and semester	1st year, 1st semester
Lecturer	Associate prof. Andrii Galkin
Teaching method	innovative, verbal, visual, practical, active and control methods with the use of the best European practices of learning
Prerequisites	Existence of the first (Bachelor's) Degree or educational qualifying level of specialist
Examination procedure	Defence of project – report (oral presentation and questions), practical part – project calculation and writing
Project foreseen	Individual course project
Aim	The *aim* is to acquire Urban Goods Flow modelling skills for residential zones considering the influence of end-consumers. The course consists of the following stages: Urban supply chain analysis. Zoning in residential area. Acquisition model in residential area. Origin-Destination matrices. Urban goods mobility, internal and external costs. Consumer goods flows in residential areas. Restocking goods flows. Assessing the full cost of supply via JIT and EOQ models. Assessing environmental impact. The *main objectives* of the module "Smart Transport and Logistics for Cities Project" are to obtain knowledge on solving urban transport problems, tools for improving the efficiency of urban logistics and transport in urban area. The acquired theoretical and practical knowledge during the study of the module will provide the necessary skills and competencies for analysing city transport systems, paying special attention to smart technologies, providing tools for solving problems, assessing the existing transport system and city logistics, alternatives and their impact. *Outcomes* of the module are that students acquire the following competencies: *students must know:* - approaches and methods for studying and managing the operation of transport systems for freight and passengers in the city; - measures to improve transport technologies using modelling of transport processes in cities; - methods of analysis of city transport and assessment of the effectiveness of systems; - approaches of the application of information communication technologies and smart transport systems in the city transport system. *students must be able to:* - assess the existing transport system and city logistics, alternatives and their impact; - investigate and manage the operation of transport systems for freight and passengers in the city; - improve transport technologies by modelling transport processes; evaluate the effectiveness of the selected activities; - apply information communication technologies and smart transport systems in the city transport system. *students must have the following competencies***:** ability to apply the acquired knowledge based on the application of techniques - analysis of urban transport systems, especially using smart transport systems and information communication technologies. - research and management of the operation of integrated transport systems; - management of urban freight, passenger transportation, traffic control; - implementation of information communication technologies and intelligent transport systems in the urban transport system.

Contents	*Content of module 1: Zoning and identifying the service area ……..* 1. Stakeholder analysis and the role of the public sector. Differences between types of urban areas. Road congestion. Conflict between UFT and pedestrians flows. Environmental pollution. Economic efficiency in urban distribution. 2. Introduction to demand modelling Study area identification, zoning, supply model building, zoning, supply modelling, random utility models, partial share modelling. *Content of module 2: Estimating demand in the study area* 3. Formation of the consumer utility function End-consumers' direct and indirect costs for purchase. Calculation time, distance, size of stores, number of inhabitants in an area and other initial parameters of a residential area. Full cost calculation. 4. Estimating O-D demand attractiveness matrix Calculation of O-D matrix according to reverse full cost utility function. 5. Modelling attractiveness of store visit for end-consumers on technological parameters Statgraphics analysis of variable influence on attractiveness of store visiting in residential areas. *Content of module 3: Urban freight transport modelling* 6. Determination of the initial data Goods type. Analysis of requirements, constrains and conditions for transportation and storing. 7. Just-in-Time (JIT) supply model simulation Urban transport simulation (macro simulation). Supply - demand interaction. Network link flow estimation (cars and trucks). Logistics cost calculations 8. Vehicle Routing problem Graphs. The network. Ant-logistics software. Intensive applications of ICT and Intelligent Transportation Systems. ITS in urban freight transport and traffic. Anylogic. 9. EOQ supply model simulation Urban transport simulation (macro simulation). Supply - demand interaction. Network link flow estimation (cars and trucks). Logistics cost calculations 10. System efficiency assessment Comparing JIT and EOQ supply models. 11. Pollution emissions Assessment of pollution emissions. Environment impact calculation: Travelled distances, Fleet. COPPERT.
Text book	1. Russo, F., & Comi, A. (2010). A classification of city logistics measures and connected impacts. Procedia-Social and Behavioral Sciences, 2(3), 6355-6365 2. Nuzzolo, A. and Comi, A. (2014). Urban freight demand forecasting: a mixed quantity/delivery/vehicle-based model. In Transportation Research Part E: Logistics and Transportation Review 65, Elsevier Ltd, 84-98. DOI: 10.1016/j.tre.2013.12.014 3. Nuzzolo, A., Comi, A. and Rosati, L. (2014). City logistics long-term planning: simulation of shopping mobility and goods restocking and related support systems. In International Journal of Urban Sciences 18 (2), Taylor & Francis, 201-217. DOI:10.1080/12265934.2014.928601, 4. Nuzzolo, A., Comi, A., Ibeas, A. and Moura, J. L. (2016). Urban Freight Transport and City Logistics Policies: Indications from Rome, Barcelona and Santander. In International Journal of Sustainable Transportation 10 (6), 552-566. DOI: 10.1080/15568318.2015.1014778. 5. Russo, F. and Comi, A. (2016). Urban Freight Transport Planning towards Green Goals: Synthetic Environmental Evidence from Tested Results. In Sustainability 2016, 8 (4), 381, DOI: 10.3390/su8040381 6. Russo, F. and Comi, A. (2011). Measures for sustainable freight transportation at urban scale: expected goals and tested results in Europe. In Journal of Urban Planning and Development American Society of Civil Engineers (ASCE), 137 (2), 142-152. DOI: 10.1061/(ASCE)UP.1943-5444.0000052 7. Russo, F. and Comi, A. (2018). From city logistics theories to city logistics planning. City

	Logistics 3 – towards sustainability and liveable cities, 8. Taniguchi, E., Fwa, T. F. and Thompson, R. G. (2013) Urban transportation and logistics: health, safety, and security concerns. Baca Raton: CRC Press. 9. Anand, N., van Duin, R., Quak, H. and Tavasszy, L. (2013) Relevance of City Logistics Modelling Efforts: A Review. Transport Reviews 35 (6), 701-719,. 10. Moshe Ben Akiva, Hilde Meersman and Eddy Van de Voorde (eds.) (2013) Freight Transport Modelling. Emerald Group Publishing Limited, United Kingdom 11. De Jong, G., Vierth, I., Tavasszy, L., & Ben-Akiva, M. (2013). Recent developments in national and international freight transport models within Europe. Transportation, 40(2), 347-371. 12. Cascetta, E. (2009). Transportation Systems Analysis: Models and Applications, Springer. 13. Galkin, A. (2017). The Role of Consumers in Logistics Systems. Transportation Research Procedia, 27, 1187-1194. 14. Ceder, A. (2015). Public transit planning and operation: Modeling, practice and behavior. CRC press. Notes by the lecturer
Support tools	MS Office (Excel, Word, PowerPoint, Visio), COPPERT, Anylogic, Ant-logistics, Statgraphics

Table 11 – Synoptic table of the Human and Environmental Impacts, Safety and Sustainability module

Title	Human and Environmental Impacts, Safety and Sustainability
Number of ECTS	5
Year and semester	1st year, 2nd semester
Lecturer	Associate prof. Iryna Tkachenko
Teaching method	innovative, verbal, visual, practical, active and control methods with the use of the best European practices of learning
Prerequisites	Existence of the first (Bachelor) Degree or educational qualifying level of specialist
Examination procedure	theoretical part – questions (written and oral), practical part – exercises
Project foreseen	-
Aim	The *aim* of the module "Human and Environmental Impacts, Safety and Sustainability" is to obtain the knowledge and skills to determine the economic, social and environmental impacts of transport systems on city logistics. The *main objectives* of the module "Human and Environmental Impacts, Safety and Sustainability" are to acquire knowledge to determine measures to improve the environment, ergonomic support in the transport sector and the human factor in ensuring the reliability and sustainability of urban logistics systems taking into account regional conditions. *Outcomes* of the module are that students acquire the following competencies: *students must know:* – assessment criteria for the driver's (operator's) reliability in the urban logistics system; – influence of the external environment on the driver's functional state: reliability, perception of information, monotony and fatigue; – models of changes of the driver's functional state in traffic congestion; – principles of vibration rationing, noise, ultrasound and infrasound, methods and means of protection from their negative impacts; – characteristics of emissions of harmful substances into the environment during car engine operation;

	– general measures to improve environmental performance; – the main principles of collection, aggregation and analysis of road accident data; – factors affecting exposure, accident rate and injury severity etc. *students must be able to:* – improve approaches and methods for conducting commercial, technical, social, environmental, institutional, financial and economic analysis in the development of innovation and investment projects; – Have the skills to study theoretical and experimental models of managing the reliability and efficiency of transport technologies by modes of transport. *students must have the following competencies***:** – ability to manage the reliability and efficiency of transport technologies by type of transport; – ability to evaluate transport systems in an urban infrastructure; – ability to determine the impacts of transport on the environment
Contents	*Content of module 1. A human factor in ensuring the reliability and sustainability of urban logistics systems* Theme 1.1: Characteristics of driver's work in the system "Human – Engineering – Environment". The structure of driver's activities. Analysis and description of activity at the operational-psychological level. The significance of analyzers, senses and perceptions of information in the driver's activity. Theme 1.2: Psycho-physiological characteristics of a driver's work in the system "Human – Engineering – Environment". The structure of the human mind. Processes of thinking and attention of a driver. Forms of fatigue and its occurrence mechanisms. Changing the reaction time of the driver taking into account types of temperament in the traffic congestions. Impacts of cars' ergonomic properties on the driver's functional condition. *Content module 2. Environmental Impacts* Theme 2.1: Environmental assessment of traffic noise of the urban road network. Acoustic load researching of the transport network. Justification of environmental measures to improve the environmental characteristics of the transport infrastructure. Theme 2.2: Environmental estimation of transport influence on air pollution in conditions of urbanization. Characteristics of parking objects as sources of environmental hazard. Types of emissions. Fuel and consumption. Rationing and ways to reduce the negative impact of vehicle exhaust. *Content module 3. Safety and Sustainability of City Logistics* Theme 3.1: The role of the human factor in ensuring the reliability and sustainability of urban logistics. The nature of errors caused by human factors. Error typology. Reliability analysis of human activity. Theme 3.2: Management of city logistics security. City Logistics Management System. Examples of transport safety management systems. The process of risk management in ensuring the sustainability of urban logistics. Theme 3.3: Sustainable Urban Mobility Plans. Sustainable mobility. New approaches to urban mobility planning. Planning a sustainable urban mobility plan.
Text book	1. Elvik R., Truls V. Handbook of road safety measures/ R. Elvik, V. Truls // Emerald Group Pub Ltd, 2009. – 1078 p.

	2. Usami D. S. Persia L., Picardi M., Saporito. Identifying driving behaviour profiles by using Multiple Correspondence Analysis and Cluster // Transport Infrastructure and Systems. 2017. – P.835-842. 3. European Commission. Developing and implementing a sustainable urban mobility plans: Guidelines. – European Platform on Sustainable Urban Mobility Plans, 2013. – 151p. 4. Essays, UK. (November 2013). Environmental Problems Linked To Developing Transport Systems Environmental Sciences Essay. 5. World Health Organization Regional Office for Europe. Transport, environment and health. – WHO regional publications. European series No. 89. – 86 p. 6. Robert G. Operator Functional State: The Assessment and Prediction of Human Performance Degradation in Complex Tasks/ G. Robert, J.Hockey, A. Gaillard. – IOS Press, 2003. – 385 p. 7. Reyes-Muñoz A. Integration of Body Sensor Networks and Vehicular Ad-hoc Networks for Traffic Safety/ A. Reyes-Muñoz, M. C. Domingo, A. López-Trinidad// Sensors. 2016. P. 101-130. Notes by the lecturer
Support tools	MS Office (Excel, Word, PowerPoint) digital sound level meter within the content module 2. Environmental Impacts

Table 12 – Synoptic table of Traffic Flow Management in the City Centre module

Title	Traffic Flow Management in the City Centre
Number of ECTS	5
Year and semester	1st year, 2nd semester
Lecturer	Associate prof. Dmytro Burko
Teaching method	innovative, verbal, visual, practical, active and control methods with the use of the best European practices of learning
Prerequisites	Existence of the first (Bachelor's) Degree or educational qualifying level of specialist
Examination procedure	theoretical part – questions (written and oral), practical part – exercises
Project foreseen	Course project is not foreseen
Aim	The *aim* of the module "Traffic Flow Management in the City Centre" is to obtain the theoretical and practical basis of traffic flow management in the city centre based on the best European practices and current methods of traffic flows management in the city centre. The *main objective* of the module "Traffic Flow Management in the City Centre" is 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. The acquired theoretical and practical knowledge during the study of the module will provide the necessary skills and competencies for analysing trends of traffic flow management in the city centre, organization of parking in the city centre, environmental management in the central part of the city. *Outcomes* of the module are that students acquire the following competencies: *students must know:* - modern approaches and methods of managing traffic flows in the city centre; - theoretical basis of organization of parking in the central part of the city; - approaches and methods for environmental management and reducing the harmful effects of traffic flows in city centres on the environment. *students must be able to:* - assess the existing system of management of traffic and pedestrian flows in the city centre, the efficiency of traffic control, the degree of influence of public and freight transport

	on traffic flow efficiency; - explore and manage the work of intelligent transport systems in city centres; - improve the system «park-and-ride» and parking lots in the city centre; - determine environmental damage from the impact of traffic flows, to develop measures to reduce the harmful effects of traffic flows on the environment. *students must have the following competencies*: - ability to apply the acquired knowledge based on the application of techniques; - use of modern methods of traffic management in city centres; - improve traffic flow management using intelligent transport systems; - the organization of parking in city centres, determining their number and location; - traffic flow management for reducing environmental damage to city centres.
Contents	*Content of module 1: Trends of Traffic Flow Management in the City Centre* 1. Modern issues of functioning of traffic flows in the centres of cities. Location of objects of attraction. Characteristics of transport networks in the central part of the cities. Access of freight transport to the city centres. Parking lots. Efficiency of traffic regulation. Public transport in the city centre. Pedestrian flows. 2. Intelligent transport systems in city centres. Basics of traffic management in the city centre. Technical resources of intelligent transport systems. Mathematical support. Implementation and operation of intelligent transport systems. System efficiency. 3. Influence of «Park and Ride» parking lots on traffic of city centres. The purpose of «Park and Ride» parking lots. Determination of demand for «Park and Ride» parking lots. Segmentation of demand. Determination of possible parking locations. Parking conditions and demand for «Park and Ride» parking lots. *Content of module 2: Parking in the City Centre* 4. Classification of parking lots. Way of parking and duration of finding cars in parking lots. Multi-level parking. Underground parking. Features of car location in transport networks of the city centre. 5. Parking characteristics of the parking lot. Schemes for placing a car in a parking lot. Determination of the number of places for cars and the area of one place per car. The dimensions of the cell for the car. Width of driveway. Radius of turns. Manoeuvring areas. 6. Parking in the centre of the city and calculating of relative requirements. Features of the organization of parking in the city centre. The ratio of the motorization level and the number of places for cars in the parking lot. Determine the area and type of parking in the city centre. *Content of module 3: Environmental Management* 7. Environmental problems of road transport. Sources of energy. Ways of reducing environmental damage from transport. 8. Evaluation of the impact of traffic flows on the environment. Characteristics of traffic flows. Determine the mileage of vehicles through the city centre network. Reducing air pollution. Reducing impacts on climatic zones.
Text book	1. Cascetta, E. (2009). Transportation Systems Analysis: Models and Applications. Springer. 2. Urban Transportation and Logistics: Health, Safety, and Security Concerns 3. Vukan R. Vuchic Transportation for Livable Cities 4. TOWARDS ZERO Ambitious Road Safety Targets and the Safe System Approach 5. Slinn M., Matthews P., Guest P. Traffic Engineering Design Principles and Practice. Second edition. — Elsevier Butterworth-Heinemann, 2005. 241 p. 6. Manual for the design of road traffic facilities: HBS 2015 / FGSV; Part A: Highways Notes by the lecturer
Support tools	MS Office (Excel, Word, PowerPoint, Visio)

Table 13 – Synoptic table of Efficiency of City Transport Systems module

Title	Efficiency of City Transport Systems
Number of ECTS	5
Year and semester	1st year, 2nd semester
Lecturer	Associate prof. Dmytro Roslavtsev
Teaching method	innovative, verbal, visual, practical, active and control methods with the use of the best European practices of learning
Prerequisites	Existence of the first (Bachelor's) Degree or educational qualifying level of specialist
Examination procedure	theoretical part – questions (written and oral), practical part – exercises
Project foreseen	graphically calculated work
Aim	The *aim* of the module "Efficiency of city transport systems" is to obtain a theoretical and practical basis for assessing the social, environmental and economic efficiency of projects in the field of transport systems and city logistics. The main *tasks* are the study of the theoretical and practical bases of project analysis, taking into account stakeholders and indicators of influence in transport systems, methods for comparing alternative projects. *Outcome* of the module is that students acquire the following competencies: **students must know**: - approaches and methods for conducting commercial, technical, social, environmental, institutional, financial and economic analysis in the development of innovative and investment projects; - approaches and methods for assessing the social, environmental and economic efficiency of transport systems and city logistics projects; - approaches and methods for comparing alternative projects. **students must be able to**: - identify stakeholders in transport systems and city logistics projects; - to carry out the analysis of the project in the field of transport systems and city logistics taking into account commercial, technical, social, environmental, institutional, financial and economic aspects; - to determine the direct and indirect effect, social, ecological and economic efficiency of projects in the field of transport systems and city logistics. - apply modern information technology to substantiate decisions in transport systems and city logistics projects. **students must have the competence**: - to assess, evaluate and compare projects in the field of transport systems and city logistics.
Contents	*Content of module 1: Project analysis, implementation of innovative and investment projects* Stakeholders in transport systems and logistics projects. Commercial, technical, social, environmental, institutional, financial and economic analysis in the development of innovative and investment projects in the field of transport systems and city logistics. *Content of module 2: Social and environmental efficiency of transport systems* Social and environmental efficiency of transport systems. Impact of the transport systems on the level of environmental pollution. Assessment of the harmful effects of cars on the environment. Approaches and methods for assessing the social and environmental effectiveness of projects. *Content of module 3: Economic efficiency of transport systems* Direct and indirect effect, approaches and methods for assessing the economic efficiency of projects in the field of transport systems and city logistics. Approaches and methods for comparing alternative projects. Multicriteria analysis for a transport infrastructure project.
Text book	1. Cascetta, E. (2009). Transportation Systems Analysis: Models and Applications. Springer.

	2. Simchi-Levi, D., Chen, X., Bramel, J. The Logic of Logistics. Theory, Algorithms, and Applications for Logistics Management Series. 3rd edition. Springer. 2014 — 454 p. 3. Taniguchi E., Russell G. Thompson (2015), City logistics: mapping the future. CRC Press, Nov 21, 2014 - Business & Economics - 231 pages. 4. Guide to Cost-Benefit Analysis of Investment Projects. Economic appraisal tool for Cohesion Policy 2014-2020. EUROPEAN COMMISSION. Directorate-General for Regional and City policy. 2014 — 364 p. 5. Multi-criteria analysis: a manual. Department for Communities and Local Government: London, 2009 — 168 p. 6. Рославцев Д. М. Проектний аналіз: функціональні аспекти реалізації проектів транспортних систем і логістики. ХНУМГ, 2013. – 275 с. 7. Аналіз вигід і витрат: Практ. посіб. /Секретаріат Ради Скарбниці Канади; Пер. з англ. С. Соколик; Наук. ред. пер. О. Кілієвич.- К: Основи, 1999.— 175 с. Notes by the lecturer
Support tools	MS Office (Excel, Word, PowerPoint, Visio), COPERT

3.3.5 Employment opportunities

Positions that can be held by a graduate: Positions of researcher, research engineer in scientific, research and design organizations. Positions of transport engineer, logistician, analyst and / or consultant in the field of transport systems and technologies. Teaching positions in higher education institutions. Opportunities to study according to the programme of the third (educational-scientific) level of higher education.

Possible place of work: public authority, department of infrastructure, transport enterprises, research and design institutes, universities etc.

Areas of activity: the implementation of organizational and management activities in state transport administration, transport departments of local governments and in transport enterprises of various forms of ownership.

3.3.6 Admission procedure

General academic access requirements

Examination procedure includes two exams: 1) external independent evaluation of foreign language; 2) internal professional entrance examination in a specialty. In accordance with the Enrolment Conditions approved by the Ministry of Education and Science of Ukraine, to be admitted to a Master's degree course, students must have at least a Bachelor's degree of any speciality.

Specific admission requirements and criteria

The Master's degree is conceived as the natural continuation of a degree in Transport Technologies speciality. Given its scientific and professional nature, it is advisable for students to have sufficient knowledge of analysis methods and transport, logistics and mobility systems for successful passing internal professional entrance exam in a specialty.

The procedure for admission to the Master's degree is based on the students rating and examination (foreign language, speciality). Rating includes average grade according to the Bachelor's degree. The dates of the admission procedure are from July to August.

3.3.7 Examination procedure for thesis defence

Obtaining the master's degree involves defence of the thesis. Students begin to write their thesis and defend it in the 4th semester. The Master's thesis includes 24 ECTS. Before starting to develop a thesis, the student has to pass all modules of the Master's programme and Specialised Pre-diploma Training. For defence of the thesis, the student develops a thesis on a topic proposed by a professor of the Transport Systems and Logistics Department.

The Master's degree sessions are set by the Head of the Educational and Methodological Department within the time intervals set in the curriculum. The date of thesis defence is 28th May 2020. The Examination Commission for thesis defence consists of five representatives – at least one external expert from industry, while the others are professors from the Department. The Examination Commission process is public and open to all stakeholders.

3.3.8 Support to students for learning and training

The Department of Transport Systems and Logistics owns the "Ergonomic and Transport Problems" and "Information Technologies" laboratories that students use during studying. The classes are also held in the laboratory of "Automated Control Systems on Transport" of NUUE. The learning process is provided by the following:

- equipment of educational premises by means of visualization (lightpro), computer equipment with

installed application software (Office 365, PTV Visum, COPERT, R-project);
- availability of modern professional literature and periodicals in the Scientific Library, in particular on working with international databases Scopus and Web of Science;
- Moodle distance learning system;
- Unichek plagiarism check system;
- educational and methodological and informational support of educational components of the programme;
- availability of material and technical support (dorm rooms with accommodation, catering complex, sports complex, medical care).

3.3.9 Tutor activity

The tutoring activity is one of the institutional tasks of professors and researchers, as an integral part of their teaching commitment aimed at guiding students' cultural education and studying support. The tutoring activities are scheduled by the Faculty at the beginning of each academic year. Each student has a tutor, who can be consulted for evaluations and general suggestions regarding the progress of the student's study activities.

3.3.10 Fees

There are two options to finance students studying: government payment (budgetary) and own student payment (contract). For budgetary payment the Ministry of Education and Science of Ukraine offers several places each year. The number of contracts from student is limited by the number of licences from the Ministry of Education and Science of Ukraine.

3.3.11 Stages

Internships for student have a duration of 4 weeks. The student can request to perform training activities such as:

- curricular internship activities (or internships) in companies, public administrations, public or

private bodies, including those in the third sector, professional orders and colleges;

- project or experimental activities approved by the Head of Department;
- introductory training activities for the preparation of the final examination to obtain the qualification.

These requests must be approved by the supervisor / tutor. At the end of the training activities, the teacher will have to assess training and fill in the exam certificate, on the training activity carried out, which must be delivered in the Faculty of Department.

3.4 Equipment and material

There are categories of equipment and material that support students and teachers in providing studying and teaching process:

- computers, software packages and peripherals equipment;
- multimedia equipment which is going to be used for visualization and direct presentation during auditorium classes;
- special technical equipment which will be used during practical training and laboratory works;
- teaching materials which is up-to-date and support Master/PhD students training;
- special software which has been revised to improve the quality of SmaLog training.

A detailed list of equipment and materials is presented in Table 14.

Table 14 – Detailed list of equipment and materials for Master Students Research Centre

Computers	**Quantity**
System unit Impression P+ (I3-7100 3.9GHz/H110/8G/SSD-120GB/1TB/DVD-RW/500W)	12
Display 21.5" LG 22M38A-B	12
Laptop ASUS X510UF-BQ003 15.6FHD AG/Intel i5-8250U/8/256SSD/NVD130-2/EOS/Grey	2
Peripherals	
Multifunctional device A4 HP LaserJet Pro M227sdn	2
Computer mouse Genius NetScroll 120 Optical Black ps/2	14
Computer keyboard Genius KB-110X Black ps/2	12
Software	
STATGRAPHICS 18 ACADEMIC LICENSES	1
Visum Academic version for Educational and Commercial Use	1
AnyLogic University Researcher	1
One Year of Maintenance and Technical Support Services for AnyLogic University Researcher (2 years)	1
Multimedia equipment (Audio-visual equipment)	
Video projector OPTOMA X305ST (3000lm, XGA, 0,62:1)	2

VGA ATcom M/M 15м (9152)	2
Wall fix for display CMPR-3-M	2
HDMI Cable 10m	1
Interactive whiteboard Newline R3-800	1
Projection screen Walfix 100" SNM-3 (152*203, 4:3)	1
Technical training (Lab material)	
Pupil world camera	1
Professional digital sound level meter Voltcraft SL-451 (30-130 дБ)	1
Xcam traffic statistics collection complex	1
Books and teaching material	
Urban Transportation and Logistics: Health, Safety, and Security Concerns	1
Public Transit Planning and Operation: Modeling, Practice and Behavior, Second Edition	1
Modelling Intelligent Multi-Modal Transit Systems	1
Transportation Systems Analysis	1

4 Conclusions

Implementation of the SmaLog Master programme will update course students with methods from the most recent international experience; update research topics in the field of smart transport and logistics for cities from the most recent international experience; involve teachers in the international research networks.

The curriculum of the SmaLog Master programme will be a basic Master's programme at the Transport Systems and Logistics Department, which will replace the existing Master's programme in Transport Systems.

Students enrolled in SmaLog curricula can also benefit from the international agreements that are under development which allow them to study and develop practical skills in some European countries (submission of proposals for E+/KA1 call).