ERASMUS+ PROGRAMME
Project Number: 585832-EPP-1-2017-1-IT-EPPKA2-CBHE-JP

Master in SMArt transport and LOGistics for cities / SMALOG

Grant Agreement Number 2017-2893/001-001

Master Curricula

development and implementation

at Zhytomyr Polytechnic State University- ZPSU

Project Acronym: SMALOG

Duration: 15/10/2017 - 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: The deliverable series presents the curricula process of the 2nd level Master developed for the Ukraine and Georgian Universities according to the Bologna process standards within the SmaLog project. This deliverable reports curriculum developed and implemented at Zhytomyr Polytechnic State University - ZPSU. After a short introduction, the deliverable describes the local conditions and needs and the results of the international reviews on which the curricula were built. The deliverable provides the structure in terms of modules, the expected learning outcomes, references to publications and the needed materials in order to deliver the Master.

Status: Final

Distribution: Public

Document ID: D.WG1.ZPSU

Date: February 19th, 2021

This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

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1 Introduction

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

The consortium consists 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 Automobiles and Transport Technologies of the Zhytomyr Polytechnic State University (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 termed "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 (1,5) University Master's programme

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, highlighting several important aspects. 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 course contents and methods 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 previously recalled results, the new Master's 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 has highlighted some interesting aspects. First of all, while Master's on Transport topics are already available in Ukraine and Georgia there is no specific Master's 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 on the Master's courses. On some Masters, there are no practical or laboratory activities whatsoever, whilst on other courses they are not extensive and need to be improved.

To avoid administrative barriers, some local academics suggest revising/extending an existing Master's programme rather than setting up a new one. This is a major opportunity since it will allow the delivery of the Master from the second year of the project and to capture local needs 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 the deliverable whose main objective is the definition of the Master's 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: objectives, the profile of Master's 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 in 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, in accordance with the Bologna process the new Masters Programme will be mainly defined as a 2/1.5 years and 120/90 ECTS 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's 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 course contents and methods for students with the most recent international experiences;
- Update research topics in the field of smart transport and logistics for cities with the most recent international experiences;
- Involve the Local Universities in the international research networks;
- To meet these needs, the Masters curricula will be based on the most recent and more 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 will be used on the one hand to improve the quality of the education and, on the other hand, to support the research.

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

activities. Moreover, the final thesis, envisaged for each Master student, will be oriented to research and practical activities rather than desk analysis.

Zhytomyr Polytechnic State University - ZPSU

Provision of training of highly qualified specialists in speciality 275 “Transport technologies”, specialization “Smart transport and logistics for cities” able to:

- implement smart transport into city transport systems,
- make decisions on the development of transport systems and logistics in cities,
- assess traffic impacts on persons and freight,
- estimate the effectiveness of city transport systems and also to prepare students for further employment in the chosen speciality, guided the implementation process of Master curriculum at Zhytomyr Polytechnic State University.

The curriculum mainly focuses on education in the field of smart urban transport merging the cultural, scientific and labour market needs. The educational-professional programme is based on the results of modern knowledge in smart transport and logistics in cities, urban passenger transport, traffic flow simulation, road traffic management, freight transportation, management of traffic flows in city centres, impact of persons and the environment on safety and stability of city logistics and also the effectiveness of city transport systems. All the above aspects enrich the participants’ professional outlook and provide the framework for a professional and scientific career.

The final educational/professional profile has four main areas of competence: passenger transportation in cities; freight transportation and logistics in cities; traffic flow management; smart transport.

3 SmaLog at Zhytomyr Polytechnic State University

3.1 Master's objectives and profile of Master's graduates

The master's degree in "Smart transport and logistics for cities" is developed within branch of knowledge 27 "Transport", speciality 275 "Transport technologies".

3.2 Programme structure

Educational-professional programme "Smart transport and logistics for cities" of the second cycle of higher education, specialty 275 Transport Technologies, branch of knowledge 27 Transport, qualification "Master" programme lasts one and a half years for a total of 90 ECTS. According to Ukrainian Law "On Education" and the Order of the Ministry of Education and Science No. 1/9-126 when developing curricula, the following rules are taken into consideration (Table 1):

- 1/3 hours – class work, 2/3 hours - independent study;
- Max 75% - compulsory discipline, Min 25% - free student choice;
- The curricula consist of two parts - Obligatory and Elective part.

Table 1 – Curriculum developed at ZPSU

OPP Code	Title	Distribution per semester				ECTS number	Number of hours							Distribution of hours by years of study and semesters		
				Coursework			Together	Auditory				Individual work		1 Year		2 Year
								Total	included:					Semesters		
		Qualification Exams	Tests	Projects	Course Papers				Lectures	Practical classes	Labs			1	2	3
														Number of weeks per semester		
														16	16	5
		1. General training cycle														
		1.1. Obligatory components														
OC.1	Foreign language professional direction	1				5	150	48			48	102	68%	3		
OC.2	Methodology and organization of research and copyright protection	2				4	120	48	16	32		72	60%		3	
OC.3	Intellectual property		2			3	90	32	16	16		58	64%		2	
OC.4	Philosophical problems of scientific knowledge	1				3	90	32	16	16		58	64%	2		
OC.5	Economic and social efficiency of urban transport systems		2			4	120	48	16	32		72	60%		3	
	Total:					**19**	**570**	**208**	**64**	**96**	**48**	**362**	**64%**	**5**	**8**	**0**
		2. Cycle of professional training														

		2.1. Obligatory components														
OC.6	Public passenger transport	1				4	120	64	32	32		56	47%	4		
OC.7	Smart transport and logistics for cities	1			1	4	120	48	16	32		72	60%	3		
OC.8	Intelligent transport systems		2			5	150	48	16	16	16	102	68%		3	
OC.9	Human and environmental impact on city logistics, safety and stability	2				4	120	48	16	16	16	72	60%		3	
		2.1.1. Practical training														
OC.10	Pre-diploma practical training		3			9	270									
OC.11	Research scientific training		3			6	180									
OC.12	Diploma	3				15	450									
	Total:					**47**	**1410**	**208**	**80**	**96**	**32**	**1202**	**85%**	**7**	**6**	**0**
		2.2. Selective components														
(The student should choose 24 ECTS based on the weekly workload)																
Block 1.																
SC.1.1	Freight transportation modelling		1			4	120	48	16		32	72	60%	3		
SC.1.2	Freight transport systems	2		2		4	120	48	16	16	16	72	60%		3	
SC.1.3	High-speed bus transportation		1			4	120	48	16	16	16	72	60%	3		
SC.1.4	Automated traffic control systems		2			4	120	48	16	16	16	72	60%		3	
SC.1.5	Smart transport		2			4	120	50	10	20	20	70	58%			10
SC.1.6	Supply chain management	1				4	120	40	15		25	80	67%			8

Block2.																
SC.2.1	Transportation planning of big cities		1			4	120	48	16		32	72	60%	3		
SC.2.2	Traffic management in city centres		2			4	120	48	16	16	16	72	60%		3	
SC.2.3	Geo-information systems		1			4	120	48	16	16	16	72	60%	3		
SC.2.4	Traffic flow modelling	2		2		4	120	48	16	16	16	72	60%		3	
SC.2.5	Special methods of traffic management	3				4	120	50	10	20	20	70	58%			10
SC.2.6	Road traffic management	3				4	120	40	15		25	80	67%			8
	Total:					**24**	**720**	**282**	**89**	**68**	**125**	**438**	**61%**	**6**	**6**	**18**
	TOTAL OF THE PROFESSIONAL TRAINING CYCLE:					**71**	**2130**	**490**	**169**	**164**	**157**	**1640**	**77%**	**13**	**12**	**18**
	TOTAL:					**90**	**2700**	**698**	**233**	**260**	**205**	**2002**	**74%**			
	Hours per week													**18**	**20**	**18**
	Number of Exams												**10**	**4**	**4**	**2**
	Number of Tests												**6**	**3**	**3**	
	Number of Projects												**1**		**1**	
	Number of Course Papers												**1**	**1**		

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

3.2.1 Obligatory part

The compulsory part counts 66 ECTS and includes - General training cycle, Cycle of professional training, Research (scientific) component. The Table below reports the modules of the project which are included in the obligatory part.

Table 2 – Modules of the project which are included in the obligatory part

Code	Components of the educational programme (training courses, course papers, practical trainings, qualification work)	ECTS credits	Form of final control
1	2	3	4
Mandatory components:			
OC.1	Foreign language professional direction	5	Exam
OC.2	Methodology and organization of research and copyright protection	4	Exam
OC.3	Intellectual property	3	Test
OC.4	Philosophical problems of scientific knowledge	3	Exam
OC.5	Economic and social efficiency of the urban transport systems	4	Test
OC.6	Public passenger transport	4	Exam
OC.7	Smart transport and logistics for cities	4	Exam Course paper
OC.8	Intelligent Transport Systems	5	Test
OC.9	Human and environmental impact on city logistics, safety and stability	4	Exam
OC.10	Pre-diploma practical training	9	Test
OC.11	Research scientific training	6	Test
OC.12	Diploma	15	
Total amount of mandatory components:		**66**	

3.2.2 Selective part

The elective part counts for 24 ECTS and includes - General training cycle, Cycle of professional training. The Table below reports the modules of the project which are included in the elective part.

Table 3 – Modules of the project which are included in the selective part

Code	Components of the educational programme (training courses, course papers, practical training, qualification work)	ECTS credits	Form of final control
SC.1.1	Freight transportation modelling	4	Test
SC.1.2	Freight transport systems	4	Exam Course paper
SC.1.3	High-speed bus transportation	4	Test
SC.1.4	Automated traffic control systems	4	Test
SC.1.5	Smart transport	4	Exam
SC.1.6	Supply chain management	4	Exam
SC.2.1	Transportation planning of big cities	4	Test
SC.2.2	Traffic management in city centres	4	Test
SC.2.3	Geo-information systems	4	Test
SC.2.4	Traffic flows modelling	4	Exam Course paper
SC.2.5	Special traffic management methods	4	Exam
SC.2.6	Road traffic management	4	Exam
Total amount:		**24**	

To obtain the master's degree the student has to obtain 90 ECTS. More details can be found at the site

https://vstup.ztu.edu.ua/magistr/275-transportni-tehnologiyi-na-avtomobilnomu-transporti/

Table 4 -Structural and logical scheme of the educational programme

Code	Components of the educational programme (training courses, course papers, practical training, qualification work)	Credits ICTS	Total hours	Summative assessment form
1	2	3	4	3
I year, I semester				
OC.1	Foreign language professional direction	5	150	Exam
OC.4	Philosophical problems of scientific knowledge	3	90	Exam
OC.6	Public passenger transport	4	120	Exam
OC.7	Smart transport and logistics for cities	4	120	Exam Course paper
Courses of block 1				
SC.1.1	Freight transportation modelling	4	120	Test
SC.1.3	High-speed bus transportation	4	120	Test
Courses of block 2				
SC.2.1	Transportation planning of big cities	4	120	Test
SC.2.3	Geo-Information Systems	4	120	Test
I year, II semester				
OC.2	Methodology and organization of research and copyright	4	120	Exam
OC.3	Intellectual Property	3	90	Test
OC.5	Economic and social efficiency of urban ansport systems	4	120	Test
OC.8	Intelligent Transport Systems	5	150	Test
OC.9	Human and environmental impact on city logistics, safety	4	120	Exam
Courses of block 1				
SC.1.2	Freight transport systems	4	120	Exam Course paper
SC.1.4	Automated traffic control systems	4	120	Test
Courses of block 2				
SC.2.2	Traffic management in city centres	4	120	Test
SC.2.4	Traffic flow modelling	4	120	Exam Course paper
II year, I semester				
OC.10	Pre-diploma practical training	9	270	
OC.11	Research scientific training	6	180	
OC.12	Diploma	15	450	
Courses of block 1				
SC.1.5	Smart transport	4	120	Exam
SC.1.6	Supply chain management	4	120	Exam
Courses of block 2				
SC.2.5	Special traffic management methods	4	120	Exam

SC.2.6	Road traffic management	4	120	Exam
	Total amount:	**90**	**2700**	

3.3 Educational objectives

3.3.1 Program competencies

Integral competence:

Ability to solve complex tasks and problems in a certain branch of professional activity or in a study process which provides for the pursuance of research and/or implementation of innovations and is characterized by uncertainty of conditions and requirements.

General competencies:

- Ability to initiate, develop and perform, individually or in a national (international) group, improvement projects in transport operations.
- Ability to organize groupwork and also motivate and manage its work.
- Ability to search, process and analyze information from different sources with the help of modern information and communication technologies.
- Ability to determine economic factors and ensure the quality of operations management during the development and realization of complex actions and projects in compliance with the conditions of work, and regulations of civil and environmental protection.
- Ability to communicate with professional and general audiences, present information in oral, printed or other forms in native or foreign languages on a professional level.
- Ability to put into practice different theories in the field of study, effectively using general pedagogical concepts.
- Ability to pursue research within a narrow specialization, detect problems, set tasks and solve them using appropriate methods of scientific research.

Professional competencies:

- Ability to study and manage the functioning of integrated transport systems.

- Ability to determine and implement promising directions of transport process simulation.
- Ability to use modern technologies of freight forwarding activity.
- Ability to perform project analysis for innovative and investment projects.
- Ability to manage supply chains and logistic centres.
- Ability to manage freight transportation by means of transport.
- Ability to manage passenger transportation by means of transport.
- Ability to research and control the movement of vehicles.
- Ability to manage the reliability and effectiveness of transport technologies by means of transport.
- Ability to use the modern methods of navigation in transport technologies by means of transport.

Professional competencies of specialty:

- Ability to use smart transport and logistics in cities.
- Ability to perform an assessment of transport systems in city infrastructure.
- Ability to manage traffic flows in cities.
- Ability to manage movement on transport network sections.
- Ability to simulate route systems.
- Ability to use information technologies in traffic flow management.
- Ability to provide consolidation of freight flows.
- Ability to use multimodal transit systems.
- Ability to design smart transport and logistics systems in cities.
- Ability to assess reliability and safety of city logistics.
- Ability to research the psychology of movement and the influence of an individual on transport system reliability.
- Ability to research and manage traffic flows in city centres.
- Ability to determine the effectiveness of city transport systems.
- Ability to determine the influence of transport on the environment.

For special (professional, technical) competencies:

- Improvement in approaches and methods for research and management of functioning of integrated transport systems.
- Justification of reasonability of measures for transport technologies improvement with the use of transport simulation processes. Conduct an assessment of effectiveness of chosen measures.
- Justification of the reasonability of implementation of modern technologies of freight forwarding services.
- Improvement in approaches and methods for performing commercial, technical, social, ecological, institutional, financial and economic analysis during development innovative and investment projects.
- Analysis and justification of the implementation of modern methods, to have the ability to conduct an analysis and calculation of economic operating rates of supply chains and logistic centres.
- Use of informational resources for improving supply chain modelling.
- Draw up measures to manage freight transportation using simulation of processes of freight transportation by means of transport.
- Draw up measures for managing passenger transportation using simulation of processes of freight transportation by means of transport.
- Analysis and justification of the expediency of scientific recommendations appliance and modern methods of vehicle movement management.
- To have skills of investigation the theoretical and experimental models of management of reliability and effectiveness of transport technologies by means of transport.
- To justify the expediency of application of modern methods of navigation in transport technologies by means of transport.

Skills:

- To analyse and develop research methods of transport processes.
- To simulate material and transport flows.

- To find optimal solutions for applying smart transport and logistics in cities.
- To estimate the effectiveness of city transport systems.
- To analyse and simulate traffic flows in city centres.
- To estimate and forecast the parameters of material and human flows.
- To estimate existing and develop progressive methods of traffic flow management.
- To forecast and design systems of smart transport in cities.
- To forecast the development of the transport services market.
- To estimate the influence of people and the environment on the safety and stability of city logistics.

Communication:

- Ability to communicate including oral and written communications in Ukrainian and at least one of the common foreign languages;
- Ability to carry out explanatory work and awareness-building among different groups and segments of the population with the aim of using smart transport and logistics in cities;
- Ability to describe the results of scientific research on smart transport and logistics in publications in specialist national and foreign publications.

Autonomy and responsibility:

- Ability to adapt to new situations and make decisions on one's own;
- Ability to aware the necessity of life-long learning with the aim of deepening of acquired and acquisition of new professional knowledge;
- Ability to be responsible for ongoing work and achieve set aims with adherence to the requirements of professional ethics.

3.3.2 Modules

The Tables below report the modules of the SmaLog degree.

Table 5 – Professional modules of the Master's programme

Module	
Economic and social efficiency of city transport systems	Table 6
Public passenger transport	Table 7
Smart transport and logistics for cities	Table 8
Traffic flow modelling	Table 9
Intelligent transport systems	Table 10
Traffic management in the city centres	Table 11
Human and environmental impact on city logistics, safety and stability	Table 12
Supply chain management	Table 13
Automated traffic control systems	Table 14
Freight transportation modelling	Table 15
Special methods of traffic management	Table 16

Table 6 –Economic and social efficiency of city transport systems

Title	Economic and social efficiency of city transport systems
Number of ECTS	4 ECTS
Year and semester	1st year, 2nd semester
Lecturer	Associate Professor Vitalii Kuchmenko
Teaching method	Classroom teaching
Examination procedure	Written and Oral
Project envisaged	Individual project
Aim	To obtain the knowledge and skills regarding smart transportation and logistics for cities. Objective: to define the challenges in urban transportation systems, namely passenger transportation, freight transportation, traffic taking into consideration intelligent transportation system and new technologies. Competences: to analyze and justify modern techniques concerning the transportation process in cities; etc. Learning outcomes: improvement of approaches and methods for research and control of the operation of the integrated transport systems in cities namely freight, passenger transportation; etc. The purpose of the course "Economic and Social Efficiency of Urban Transport Systems" is to develop a system of knowledge and understanding of conceptual bases of organization and management of passenger transportation of socially protected sections of the population, to acquire skills in managing technological processes of passenger transportation. The subject of the course is methods of organizing passenger transportation of socially protected population groups. The objective of the discipline "Economic and Social Efficiency of Urban Transport Systems" – is also to teach students the effective organization of passenger transportation of socially protected sections of the population and management of transport systems of passenger transportation of socially protected segments of the population and technological processes of transportation, which is associated with perfect knowledge of the organization and technology of processes that occur transport systems.
Contents	Effective pricing policy. Factors affecting the demand for transportation. Weighted tariff system.

	Improvement in the transport system infrastructure. Improving the quality of public transport. Investment attractiveness of public transport. Scripts of development of transport systems. Topic 1. Methods of improving urban passenger transport systems in the context of servicing socially protected sections of the population. Theme 2. Graph-analytical calculation of routes, taking into account the needs of socially protected strata of the population. Theme 3. Methods of choosing modes of traffic of vehicles on routes of urban passenger transport taking into account the performance of social function. Theme 4. Formation of regional passenger transport routes and organization of suburban routes to meet the needs of socially protected sections of the population. Topic 5. Analysis of economic efficiency of the organization of routes. Methods of organizing the movement and operation of vehicle crews in passenger transportation of socially protected sections of the population Topic 6. Methods of organizing the movement and operation of vehicle crews to meet the needs of socially protected sections of the population. Topic 7. Traffic timetables taking into account the needs of socially protected strata of the population. Topic 8. State regulations of passenger transportation of socially protected sections of the population. Theme 9. Assessment of the competitiveness of urban passenger transport services in the context of servicing socially protected sections of the population. Topic 10. Documentation of the transport process of passenger transportation of socially protected sections of the population.
Textbooks	1. BENJAMIN, J., OBENG, K. The effect of policy and background variables on total factor productivity for public transit. Transportation Research 24B (1), 1–14, 1990. 2. Системологія на транспорті: Підручник: У 5 кн. – К.: Знання України, 2005 – Кн. IV: Організація дорожнього руху / Е.В.Гаврилов, М.Ф.Дмитриченко, В.К.Доля, О.Т.Лановий, І.Е.Линник, В.П.Поліщук. 2007. – 451 с.; 3. Організація та регулювання дорожнього руху: підручник / за заг. ред. В.П.Поліщука. – К., Знання України, 2011. - 467 с.; 3. FIELDING, G.J., GLAUTHIER, LAVE, C.A. Performance indicators for transit management. Transportation 7, 365–379, 1978 4. NOLAN, J.F. Determinants of productive efficiency in urban transit. Logistics and Transportation Review 5. Marunich VS, Shmorgun LG etc. Organization and management of passenger transportation: a textbook / ed. Assoc. V.S. Marunich, prof. L.G. Shmorgun - K .: Millennium, 2017. - 528 p. 6. The share of VK Passenger transportation: A textbook. - Kharkov: ViewFort, 2011. - 504 p. 7. Kristopchuk ME Suburban passenger transportation: a textbook / [M.E. Kristopchuk, OO Lobashov] - X .: NTMT, 2012. - 224p. 8. Vakulenko KE Urban passenger transport management: textbook. manual / KE Vakulenko, KV Share; Kharkiv. nat. un-t the city. to them. OM Beketova. - Kharkiv: KhNUMG them. OM Beketova, 2015. - 257 p. 9. DavidichYu.O. Development of a timetable for the movement of vehicles in the organization of passenger transportation: study. tool. / Yu. O. Davidich; Hark. nat. Acad. the city. master. - X .: KNAMG, 2010. - 345 p. 10. Kristopchuk ME The socio-economic efficiency of the suburban passenger transport system: monograph / ME Kristopchuk. - Exactly: NSUPP, 2012. - 158 p. / [Electronic resource]. - Access mode: http://ep3.nuwm.edu.ua/id/eprint/1645. 11. Passenger road transportation: VA Gudkov, L.B. Mirotin, A.V. Grandmaster. M .: Hotline - Telecom, 2006. - 448 p.
Support tools	R-project MS Office (Excel, Word, PowerPoint)

Table 7 – Public passenger transport

Title	Public passenger transport
Number of ECTS	4 ECTS
Year and semester	1st year, 1st semester
Lecturer	Associate Professor Andrii Ilchenko
Teaching method	Classroom teaching

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

Table 8– Smart transport and logistics for cities

Title	Smart transport and logistics for cities
Number of ECTS	4 ECTS
Year and semester	1st year, 1st semester
Lecturer	Professor Oleksandr Kravchenko
Teaching method	Classroom teaching
Examination procedure	Written and Oral
Project envisaged	Individual project
Aim	1. To improve approaches and methods for studying and managing the operation of smart transport systems. 2. To analyze and substantiate the application of modern methods, to have the ability to analyze and calculate the economic performance of the chain of supply and logistics centres. Using information resources to simulate supply chains. 3. To have skills in research of theoretical and experimental models of reliability management and efficiency of transport technologies by types of transport.

	4. To analyze and develop transport research methods 5. To find optimal solutions for the application of intelligent transport and logistics in cities. 6. To predict and design smart city transport systems.
Contents	Analysis of transport networks. Functional principles of intelligent transport application. Network models and their use in urban logistics. Application of individual components of ITS. Methods of management of intelligent transport. Distribution strategies. Structure and functionality of the logistics network. The problem of arcing routing algorithms for accurate and approximate routing problems. Definition of logistic networks. Multi-level inventory management.
Textbooks	1. Cascetta, E. (2009). Transportation Systems Analysis: Models and Applications. Springer. 2. Stock J, Lambert D (2001), Strategic Logistics Management, McGraw-Hill 3. Sussman, J. S. Perspectives on Intelligent Transportation Systems (ITS) [Текст] / Joseph S. Sussman. – Springer, 2005. – 229 p. 4. Chopra S., Meindl P., (2010) Supply chain Management. Strategy Planning Operation" 5. Ceder, A. (2015) Public Transit Planning and Operation: Modeling, Practice and Behavior, Second Edition - CRC Press Book. 6. Mogre, R. Intelligent Transportation Systems: A Private Organizations Perspective [Текст] / Riccardo Mogre. LAP Lambert Acad. Publ., 2010. – 156 p. 7. Hyndman, R. B. and Athanasopoulos, G. (2018) Forecasting: principles and practice. https://www.otexts.org/book/fpp2. 8. Support tools R - R Project for Statistical Computing MS Office (Excel, Word, PowerPoint). 9. F Russo, C Rindone (2011) The planning process and logical framework approach in road evacuation: a coherent vision. WIT Transactions on the Built Environment 117, 415-425. 10. C Rindone (2019) Urban transport planning, ITS and energy resources: a framework for smart city case studies. WIT Transactions on The Built Environment 188, 107-117
Support tools	PTV Visum Pupil world camera Regression analysis Analysis methods Mobile Mapping Systems MS Office (Excel, Word, PowerPoint)

Table 9– Traffic flow modelling

Title	Traffic flows modelling
Number of ECTS	4 ECTS
Year and semester	1st year, 2nd semester
Lecturer	Associate Professor Volodymyr Shumliakivskyi
Teaching method	Classroom teaching
Examination procedure	Written and Oral
Project envisaged	Individual project
Aim	• Ability to organize group work and also motivate and manage its work. • Ability to search, process and analyze information from different sources with the help of modern information and communication technologies. • Ability to communicate with professional and general audiences, present information in oral, printed or other forms in a native or foreign language on a professional level. • Ability to apply in practice different theories in the field of study, effectively using general pedagogical concepts. • Ability to pursue research within a narrow specialization, detect problems, set tasks and solve them using appropriate methods of scientific research. • Ability to study and manage the functioning of integrated transport systems. • Ability to determine and implement promising directions of transport process simulation. • Ability to research and control the movement of vehicles. • Ability to use the modern methods of navigation in transport technologies by means of transport • Ability to use smart transport and logistics in cities.

	• Ability to conduct an assessment of transport systems in city infrastructure. • Ability to operate traffic flows in cities. • Ability to operate the movement on transport network sections. • Ability to simulate route systems. • Ability to use information technologies in traffic flow management. • Ability to design smart transport and logistics systems in cities.
Contents	While studying this discipline, the student acquires theoretical and practical knowledge and skills in developing and organizing traffic flow schemes, including: regulated and unregulated intersections. It is based on the results of laboratory work and course projects, conducting individual studies on modelling such processes on computers. It discusses in detail the various modelling options using PTV software products and defines the main indicators of traffic flow efficiency at intersections. The whole complex of such information meets the requirements of current norms, standards and methods of traffic safety organization.
Textbooks	1. Sy`stemologiya na transporti / Za zag.red. M.F.Dmy`try`chenka.- Kny`ga 1: Osnovy` teoriyi sy`stem i upravlinnya / Ye.V.Gavry`lov, M.F.Dmy`try`chenko, V.K.Dolya ta in.- K.: Znannya Ukrayiny`, 2005.-344 s. 2. Semenov V.V. Matematycheskoe modelyrovany`e dynamyky transportnykh potokov megapolysov/ V.V.Semenov. M.V.Keldysha RAN-M., 2004.- 44 s. 3. Majorov N. N. Modely`rovany`e transportny`x processov: Uch. posob. / N. N.Majorov, V.A. Fety`sov.- M.:Transport, 2013.-164 s. 4. Dryu D. Teory`ya transportnых potokov y` upravleny`e y`my` / D.Dryu.-M.:Transport, 1972.-424 s. 5. Brajlovsky`j N.O. Modely`rovany`e transportny`x sy`stem / N.O.Brajlovsky`j, B.Y`.Granovsky`j.-M.: Transport, 1978.-125 s. 6. Fornal`chy`k Ye.Yu. Upravlinnya dorozhnim ruxom na regul`ovany`x perexrestyax u mistax / Ye.Yu.Fornal`chy`k, I.A.Mogy`la, V.E.Trushevs`ky`j, V.V.Gilevy`ch/ Monografiya za zag.red.prof. Ye.Yu.Fornal`chy`ka.-L`viv:Vy`d-vo L`vivs`koyi politexniky`, 2018.-236 s. 7. Buslenko N.P. Modely`rovany`e slozhnых sy`stem / N.P.Buslenko.-M.: Nauka, 1968.-435 s. 8. Sy`l`yanov V.V. Teory`ya transportnых potokov v proekty`rovany`y` dorog y` organy`zacy`y` dvy`zheny`ya / V.V.Sy`l`yanov.-Transport, 1977.-303 s. 9. Xejt F. Matematy`cheskaya teory`ya transportnых potokov / F.Xejt.-M.:My`r, 1966.-380 s.
Support tools	PTV Software Algorithms and methods of mathematical statistics Algorithm and methods for processing the results of video observations Synthesis of domestic and foreign information sources Radar for traffic data collection

Table 10– Intelligent transport systems

Title	Intelligent transport systems
Number of ECTS	5 ECTS
Year and semester	1st year, 2nd semester
Lecturer	Associate Professor Volodymyr Shumliakivskyi
Teaching method	Classroom teaching
Examination procedure	Written and Oral
Project envisaged	Individual project
Aim	1. To simulate multimodal transport networks; 2. To make predictions of state variables and behaviour of transport network users; 3. To simulate multimodal transport networks in real time; 4. To support users in multimodal networks; 5. To design and manage multimodal intelligent transport systems operatively; 6. To improve demand and supply model parameters.
Contents	ITS planning. Services for ITS users. Network models and their use in transport engineering. Forecast of network status variables. New technologies of ITS. Systems for monitoring, collecting and sending information about vehicles. Elements of the vehicle-infrastructure, user-control centre. Real-time transport network forecasting. Specification, calibration and testing of ITS models. Examples of

	application of ITS models.
Textbooks	1. Cascetta, E. (2009). Transportation Systems Analysis: Models and Applications. Springer. 2. Ortuzar S, J. D. D. and Willumsen, L. G. (2001). Modeling transport. Chichester New York, J. Wiley. 3. Sussman, J. S. Perspectives on Intelligent Transportation Systems (ITS) [Текст] / Joseph S. Sussman. – Springer, 2005. – 229 p. 4. Ceder, A. (2015) Public Transit Planning and Operation: Modeling, Practice and Behavior, Second Edition - CRC Press Book. 5. Mogre, R. Intelligent Transportation Systems: A Private Organizations Perspective [Текст] / Riccardo Mogre. LAP Lambert Acad. Publ., 2010. – 156 p. 6. Hyndman, R. B. and Athanasopoulos, G. (2018) Forecasting: principles and practice. https://www.otexts.org/book/fpp2. 7. Support tools R - R Project for Statistical Computing MS Office (Excel, Word, PowerPoint).
Support tools	PTV Visum Pupil world camera Regression analysis Analysis methods Mobile Mapping Systems

Table 11 – Traffic management in city centres

Title	Traffic management in city centres
Number of ECTS	4 ECTS
Year and semester	1st year, 2nd semester
Lecturer	Associate Professor Ruslana Kolodnytska
Teaching method	Classroom teaching
Examination procedure	Written and Oral
Aim	1. To appoint necessary technical means of the organization of traffic at designing or reconstruction of objects of traffic management; 2. To carry out research of a condition of a level of safety of traffic with the use of qualitative, quantitative and topographical analysis of traffic events; 3. To study traffic parameters; 4. To choose optimal conditions for the management of transport processes to ensure the maximum efficiency of these processes at a given level of security.
Contents	Traffic light control at a separate intersection. Adjustment by phases (steps). Adjustment by signalling groups. Adaptive software control. Coordinated traffic control. Parameters of the coordination programme and their definition. Adaptive coordinated management. Provision of priority traffic of city shuttle passenger transport. Contact and non-contact priority of travel. Application of smart transport systems for traffic control. Information system for passengers. Pedestrian control in regulated and unregulated areas. Light traffic control taking into account the characteristics of pedestrian streams. Organization of pedestrian traffic and underground pedestrian traffic. Information systems for pedestrians. Securing the pedestrian movement Organization of cycling on the lines of traffic and at intersections. Light traffic control with regard to cycling. Organization of parking places for bicycles. Information system for cyclists. Ensuring the safety of cyclists. Arrangement of ramps at crossroads, overground and underground pedestrian crossings. Sound signals at regulated intersections. Use of tactile signals on sidewalks, intersections and public transport stops. Traffic management on city streets through the TRANSYT method. Automated centralized intelligence systems (SCOOT, SCATS). Automated control systems with decentralized intelligence (MOTION). The appointment of intelligent transport systems and their hierarchy. Navigation systems. Subsystem of traffic control in dangerous situations. Subsystem of information support for participants of movement. Parking features in cities. Classification of parking lots. Mode of storage and duration of finding cars in the parking lot. Features of stopping cars on the street-road network. Multilevel underground and aboveground parking. Planning characteristics of parking lots. Car placement schemes. Determine the number of cars and the area of one car on the parking lot. Width of fares. Turning radius. Manoeuvring zones

	Payment methods for using a car park. Design zones of paid parking. Parking facilities. Parking and parking features like "Park and Ride". Park and Ride management system. Technical subsystems of "Park and Ride" parking type. Features of the organization of parking in the city centre. The ratio of the level of motorization to the number of parking places. Determination of the area and type of parking in the city centre. Capacity of multi-level parking in city centres. Parking plans. Providing drivers with information on availability of free places. Systems for the arrangement of vehicles. International standard ISO 14000 Environmental Management. European emission standards (Euro 6) Subsystem of collecting and processing of information on toxic emissions of transport flows. Subsystem of traffic organization taking into account the requirements of environmental protection.
Textbooks	1. City Planning and Transportation: Tutorial / OS. Bezlyubchenko, SM Gordienko, OV Zavalny. - Kharkiv: KNAMG, 2006. - 138 p. 2. M.M. Zhuk, IV Konik, Y.Ya. Roiko, B.M. Diveev, R.B. Rogalsky. Traffic research on the city road network: a workshop for laboratory work. - Lviv: NU "LP", 2007. - 39 p. 3. E. Cascetta. Transportation Systems Analysis - Models and Applications (http://www.springer.com/it/book/9780387758565). 4. Applied Time Series Analysis with R. Wayne A. Woodward, Henry L. Gray, Alan C. Elliott (https://www.crcpress.com/Applied-Time-Series-Analysis-with-R-Second-Edition/ Woodward-Gray-Elliott / p / book / 9781498734226). 5. EV Gavrilov, MF Dmitrichenko, V.K. Fate, O.T. Lanow, I.E. Linnik, VPPolischuk. Traffic organization. - K .: Knowledge of Ukraine, 2005. - 452s. 6. Kremenets Yu.A. Technical means of traffic organization: Textbook for universities / Yu.A. Kremenets, M.P. Pechersky, M.B. Afanasiev. - M .: ICC "Akademknig", 2005. - 280 p. 7. I.A. Vikovich, M.M. Beetle, Y.Ya. Roiko. Traffic organization. - Lviv: NU LP, 2006. - 162 p. 8. Road signs. General specifications. Application Rules: DSTU 4100-2002 - [Effective June 03, 2002]. - K.: State Standard of Ukraine, 2002. - 63 p. 9. Rules for the location and equipment of stops for urban electric and road transport: Resolution of the Cabinet of Ministers of Ukraine of March 30, 1994 N 198. - K., 1994. - 10 p. 10. Road marking. Technical requirements. Control methods. Terms of use: DSTU 2587-2010. - K.: State Standard of Ukraine, 2010. - 70 p. 11. Traffic lights are road. General specifications, application rules and safety requirements: DSTU 4092-2002. - K.: State Standard of Ukraine, 2002. - 21 p. 12. VV Silyanov, ER Domke. Transport and operational qualities of highways and city streets. - M .: AC "Academy", 2008. - 352s. 13. Drew D. The theory of transport flows and their management / Trans. with English. - M .: Transport, 1972.-423 p. 14. AG Levashev Designing adjustable intersections: Textbook. manual / A.G. Levashev, A.Yu. Mikhailov, I.M. Chief. - Irkutsk: Publishing house of IrGTU, 2007. - 208 p. 15. http://www.didattica.uniroma2.it/informazioni/index/insegnamento/174920-Teoria-Dei-Sistemi-D-Trasporto-1-2. 16. “Traffic Rules”: Official Edition. - Kiev: ASK, 2018. - 64 p.
Support tools	*PTV Visum* *Statgraphics* *MS Office*

Table 12– Human and environmental impact on the cities logistics, safety and stability

Title	Human and environmental impact on the cities logistics, safety and stability
Number of ECTS	4 ECTS
Year and semester	1st year, 2nd semester
Lecturer	Assistant Professor Volodymyr Titarenko Assistant Professor Volodymyr Shlapak
Teaching method	Classroom teaching
Examination procedure	Written and Oral
Aim	1. Ability to initiate, develop and perform individually or in national (international) group projects on

	operations improvement on transport. 2. Ability to organize the group work and also motivate and manage its work. 3. Ability to use modern technologies of freight forwarding activity. 4. Ability to research and control the movement of vehicles 5. Ability to use smart transport and logistics in cities. 6. Ability to conduct an assessment of transport systems in city infrastructure. 7. Analyze and justify expediency of scientific recommendations appliance and modern methods of vehicle movement management. 8. Analyze and simulate traffic flows in city centers. 9. Ability to describe the results of scientific research on smart transport and logistics in publications in national and foreign specialized publications.
Contents	While studying this discipline, the student acquires theoretical and practical knowledge and skills in studies of traffic indicators and forecasting their changes in time. Also detailed the documentary studies and modelling of movement in specialized software environments. Detailed the methods of the traffic flow indicators measuring. Analyzed methods for assessing the physiological indicators of the vehicle`s driver. Students using computer technology can research the indicators of the driver`s functional state.
Textbooks	1. Systemologiya na transporti. Texnologiya naukovyx doslidzhen i texnichnoyi tvorchosti [Gavry`lov E. V., Dmy`try`chenko M. F., Dolya V. K. ta in.] ; za red. M. F. Dmy`try`chenka. – K. : Znannya Ukrayiny`, 2007. – 318 s. – (5 kn./ Gavry`lov E. V., Dmy`try`chenko M. F., Dolya V. K. ta in.; kn. 2). 2. Systemologiya na transporti. Organizaciya dorozhnogo ruxu [Gavry`lov E. V., Dmy`try`chenko M. F., Dolya V. K. ta in.]; za red. M. F. Dmy`try`chenka. – K. : Znannya Ukrayiny`, 2007. – 452 s. – (5 kn./ Gavry`lov E. V., Dmy`try`chenko M. F., Dolya V. K. ta in.; kn. 4). 3. Cascetta, E. (2009). Transportation Systems Analysis: Models and Applications. Springer. 4. Ortu?zar S, J. D. D. and Willumsen, L. G. (2001). Modeling transport. Chichester New York, J. Wiley. 5. Hyndman, R. B. and Athanasopoulos, G. (2018) Forecasting: principles and practice. https://www.otexts.org/book/fpp2 6. Ceder, A. (2015) Public Transit Planning and Operation: Modeling, Practice and Behavior, Second Edition - CRC Press Book. 7. Dryu D. Teory`ya transportnых potokov y` upravleny`e y`my` / D. Dryu; per. s angl. E. G. Kovalenko. – M.: Transport, 1972. – 0423 s. 8. Xomyak Ya. V. Organy`zacy`ya dorozhnogo dvy`zheny`ya / Ya. V. Xomyak. – K. : Vыsshaya shkola, 1986. – 276 s. 9. Sy`stemologiya na transporti. Ergonomika / [Gavry`lov E. V., Dmy`try`chenko M. F., Dolya V. K. ta in. ] ; pid red. M. F. Dmy`try`chenka. – [5-ta kny`ga] – K. : Znannya Ukrayiny`, 2008. – 256 s. 10. Polishhuk V. P. Teoriya transportnogo potoku : metody` ta modeli organizaciyi dorozhn`ogo ruxu / V. P. Polishhuk, O. P. Dzyuba. – K. : Znannya Ukrayiny`, 2008. – 175 s. 11. Drejner N. Pry`kladnoj regressy`onnыj analiz / N. Drejner, G. Smy`t. – M.: Staty`sty`ka, 1973. – 392 s.

Table 13–Supply chain management

Title	Supply chain management
Number of ECTS	4 ECTS
Year and semester	2nd year, 1st semester
Lecturer	Professor Oleksandr Kravchenko
Teaching method	Classroom teaching
Examination procedure	Written and Oral
Project envisaged	Individual project
Aim	To obtain the knowledge and skills regarding “Supply chain management”. Objective: to define the challenges of the flow of goods and services and include all processes that transform raw materials into final products. It involves the active streamlining of a business's supply-side activities to maximize customer value and gain a competitive advantage in the marketplace. Competences: to analyze and justify the flow of goods and services and include all processes that transform raw materials into final products.

	Learning outcomes: improvement of approaches and methods for research and control of the operation of the flow of goods and services (freight, passenger transportation) etc.
Contents	Topic 1 Supply Chain is the evolutionary stage of logistics management Topic 2. Conceptual apparatus of the supply chain and its management Topic 3. Designing Supply Chains Topic 4. Decision Making in Supply Chain Management Topic 5. Supply chain strategies and integration and collaboration across supply chains Topic 6. Requirements for the transportation process and information support system Topic 7. Criteria and constraints in supply chain management Topic 8. Managing the global supply chain
Textbooks	1. Bowersox Donald J., Kloss David J. Logistics: Integrated Supply Chain. 2nd ed. / Per. from English - M.: CJSC Olymp-Business, 2005. - 640 p. 2. Varfolomeev V.N., Potaman N.V. Inventory management in road transport. - Kharkov: KHNADU, 2006 .-- 116 p. 3. Ivanov D.A. Supply Chain Management. / D.A. Ivanov. - St. Petersburg: Publishing House SPbSPU, 2009. - 660 p. 4. Mirotin LB Integrated logistics of storage and distribution complexes (warehouses, transport hubs, terminals). - M.: Exam, 2003 .-- 448 p. 5. Nefodov M.A. Managing postanch lancers. Synopsis of lectures. - Kharkiv: KHNADU, 2015 .-- 103 p. 6. Nikolaychuk V.E., Kuznetsov V.G. Theory and practice of material management. Monograph. - Donetsk: KITIS, 1999. - 413 p. 7. Nikolaychuk V.E. Procurement and production logistics. Textbook The allowance - St. Petersburg .: Peter, 2001 .-- 160 p. 8. Prunenko D.O. Managing postanch lancers. Synopsis of lectures. - Kharkiv: KHNUM im. O.M. Beketova, 2016 .-- 140 p. 9. Workshop on logistics: Textbook. allowance / Ed. B.A. Anikina. - M .: INFRA-M, 2000 .-- 270 p. 10. Radionov A.R. Logistics: rationing of sales stocks and working capital of an enterprise: Textbook. - M .: Marketing, 2002 .-- 448 p.
Support tools	Analysis methods Mobile Mapping Systems MS Office (Excel, Word, PowerPoint)

Table 14– Automated traffic control systems

Title	Automated traffic control systems
Number of ECTS	4 ECTS
Year and semester	1st year, 2nd semester
Lecturer	Associate Professor Dmytro Beherskyi
Teaching method	Classroom teaching
Examination procedure	Written and Oral
Project envisaged	Individual project
Aim	To obtain the knowledge and skills regarding smart transport. Objective: to define the challenges in urban transportation system, namely passenger transportation, freight transportation, traffic taking into consideration intelligent transportation system and new technologies. Competences: to analyze and justify modern techniques concerning the transportation process in cities. Learning outcomes: improvement of approaches and methods for research and control of the operation of integrated transport systems in the cities namely freight, passenger transportation, etc,
Contents of part 1 Information Technologies in Traffic Management	Road traffic monitoring systems Traffic intensity, speed of traffic in real time. Traffic management decisions in real time. Methods of road traffic research. Methods of registration of vehicles on the road. Video monitoring of traffic. Traffic management centres. 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. Control and guidance for drivers Road signs, road surface markings, information to drivers and pedestrians. Online information for car park usage, pedestrian crossing usage, areas of low and high congestion, frequency, location and cause of road works. Network and traffic management systems ITS for the road network. Monitoring methods and technologies. Urban traffic management Classification of vehicle safety systems Classification of electronic vehicle safety systems. Electronic systems used in road vehicles: engine electronics, transmission electronics, chassis electronics. Passenger comfort. Infotainment systems. Active safety of vehicles Anti-lock braking system, electronic stability control, chassis assist, intelligent speed adaptation, brake assist, traction control, collision warning avoidance, adaptive or autonomous cruise control system. Passive safety of vehicles Passenger safety cell, deformation zones, seat belts, loadspace barrier-nets, air-bags, laminated glass, correctly positioned fuel tanks, fuel pump kill switches. Crash test car. Modern traffic safety systems System to prevent crashes caused by fatigue. Monitoring of the functional state of the driver. Sobriety detectors. Driver assistance systems that help the driver detect obstacles and drive a vehicle. Autonomous car. Safety of vehicles in the future. Classification of satellite navigation systems Civil and military uses. Global navigation satellite systems (GPS, GLONASS, Galileo, BeiDou-2). Regional navigation satellite systems (BeiDou-1, NAVIC, QZSS). Principles of satellite navigation systems operation Basic elements of satellite navigation. Principles of work. 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 vehicle traffic parameters by satellite navigation. Transport management using satellite navigation systems Features of application of navigation systems on transport. Features of navigation systems. Information support for navigation systems. Control of the operation of transport using navigation systems. Selection of traffic routes. Simulation of transport parameters by means of satellite navigation systems.
Textbooks	1. Cascetta, E. (2009). Transportation Systems Analysis: Models and Applications. Springer. 2. Ortúzar S, J. D. D. and Willumsen, L. G. (2001). Modeling transport. Chichester New York, J. Wiley. 3. Nuzzolo, A. and Lam, W. H. K. (eds. 2017), Modeling Intelligent Multi-Modal Transit Systems, CRC Press, Taylor & Francis Group, Boca Raton (FL, USA) 4. DG MOVE. European Commission: Study on Urban Freight Transport. FINAL REPORT. MDS Transmodal Limited in association with Centro di ricerca per il Trasporto e la Logistica (CTL), 2012. 5. City Logistics Research. A Transatlantic Perspective. Summary of the First EU-U.S. Transportation Research Symposium. Transportation Research Board of the National Academies, Conference Proceedings 50, 2013, 98 P. (p. 18) 6. The Seventh Framework Programme for R&D, Theme 3 “Information and Communication Technologies”. Smart freight transport in urban areas. Available at http://www.smartfreight.info .
Support tools	PTV Visum Pupil world camera Mobile Mapping Systems

Table 15 – Freight transportation modelling

Title	Freight transportation modelling
Number of ECTS	4 ECTS
Year and semester	1st year, 1st semester
Lecturer	Associate Professor Volodymyr Shumliakivskyi
Teaching method	Classroom teaching
Examination procedure	Written and Oral
Project work	Individual project
Aim	1. To improve approaches and methods for research and management of the operation of integrated transport systems. 2. To explain feasibility of measures for improving freight transportation systems taking into account logistics using simulation. Evaluate the effectiveness of selected activities. 3. To analyze and substantiate expediency of application of scientific recommendations and modern methods of management of freight transportation. 4. To have skills in research of theoretical and experimental models of management of reliability and efficiency of transport technologies by types of transport. 5. To substantiate expediency of application of modern navigation methods in managing freight traffic.
Contents	Urgency of modelling freight transportation processes. Cargo and cargo turnover. Features of freight transportation. Modelling the process of cargo transportation planning. Application of mathematical methods in the organization of cargo transportation. Reliability of the logistics system of cargo delivery. Methods of forming freight transport models. Modelling freight traffic in international traffic. Organization and management of main and centralized cargo transportation. Transport safety.
Textbooks	1. Tavasszy, L. and De Jong, J. (eds; 2014), Modeling Freight Transport, Elsevier, ISBN: 978-0-12-410400-6, 2014 2. Ben Akiva, M., Hilde Meersman and Eddy Van de Voorde (eds.; 2013), Freight Transport Modeling, Emerald Group Publishing Limited. 3. Rodrigue, J.P. (2013). The Geography of Transportation Systems. Routledge - Taylor & Francis Group. 4. Daganzo, C. F. (1991). Logistics Systems Analysis. Springer-Verlag. 5. Nuzzolo, A., Crisalli, U. and Comi, A. (2015). An aggregate transport demand model for import and export flow simulation. In Transport 30 (1), DOI:10.3846/16484142.2013.820215, Francis & Taylor, 43-54 6. Nuzzolo, A., Crisalli, U. and Comi, A. (2013). Ex-ante assessment of road transport emissions: application to the Italian case. In External costs of transport systems: theory and applications – Selected papers, U. Crisalli, E. Cipriani and G. Fusco (eds.), Franco Angeli Editore, Milan, chapter 14, 210 – 224. 7. Russo, F., Vitetta, A. and Comi, A. (2009). Estimation of target time distribution for agri-food products by road transport. In Schedule-Based Modeling of Transportation Networks: Theory and Applications, N. H. M. Wilson and A. Nuzzolo (eds.), DOI: 10.1007/978-0-387-84812-9_14, Springer Science + Business Media, 267 – 283. 8. 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 Modeling –Lessons from freight sector , chapter 7, Emerald Group Publishing Ltd. 9. Polimeni, A., Russo, F., Vitetta, A., (2010). Demand and routing models for urban goods movement simulation. *European Transport* , 46, pp. 3 – 23. 10. Nuzzolo, A., Comi, A., (2014). City Logistics Planning: Demand Modeling Requirements for Direct Effect Forecasting. *Procedia - Social and Behavioral Sciences*, Volume 125, 20 March 2014, pp. 239 – 250. 11. Nuzzolo, A., Comi, A., (2015). Modeling challenges to forecast urban goods demand for rail. *Transport Problems*, 10 (4). pp. 75 – 90.
Support tools	*PTV Visum* *Statgraphics* *MS Office*

Table 16–Special methods of traffic management

Title	Special methods of traffic management
Number of ECTS	4 ECTS
Year and semester	2nd year, 1st semester
Lecturer	Associate Professor Dmytro Beherskyi
Teaching method	Classroom teaching
Examination procedure	Written and Oral
Project work	Individual project
Aim	To obtain the knowledge and skills regarding special methods of traffic management. **Competence** Ability to research and manage special methods of traffic management. **Learning outcomes** After studying the course the students will acquire the following areas of expertise: ✓ ***technological*** - by scientific formation of measures and requirements for solving traffic safety problems in order to improve safety levels and eliminate the concentration of road accidents on public roads, at railway crossings and on urban streets by improving those presented in the professional literature or creating new methods and techniques; ✓ ***organizational*** - by means of scientific substantiation of methods of maintenance of public highways, streets and roads of settlements, railway crossings in a safe-for-road-traffic condition in the autumn-winter period; ✓ ***analytical*** - through the scientific selection of alternatives to the project and definition of: 1) its main parts that affect their preparation and implementation; 2) the main purpose and hierarchy of project goals; 3) the type and type of project; ✓ ***design*** - by qualitative analysis of the interaction of road conditions and traffic flows and road accidents at the places of their concentration with the help of certain methods for formation of engineering-planning and organizational measures, as well as carrying out an assessment of the possibility of using technical means of traffic organization and drawing up a preliminary scheme of their deployment to ensure a high level of road safety; ✓ ***control*** - through scientific justification of traffic control on the network of public roads, railway crossings and urban streets and the use of normative documentation and records obtained in commission surveys, improving road maintenance and road networks for the purpose of road safety.
Content	Theme 1. The state of the road movement organization in modern road conditions. Theme 2. Driving conditions and conditions of motor roads in weather weather. Theme 3. Traffic safety under harsh weather conditions. Theme 4. Developing measures to ensure the pedestrian safety. Topic 5. Organization of road movement on transport networks. Theme 6. Dynamic organization of transport. Specific problems for regulating traffic in cities and towns.
Textbooks	1. Bezpeka ruhu automobilnogo transportu // D.V. Zerkalov, P.R. Levkovets, O.I. Melnichenko, O.M. Dmitriev: Dovidnik. - K .: Osnova, 2002 .-- 360 p. 2. Silyanov V.V. Transport and operational qualities of roads and city streets / V.V. Silyanov, E.R. Domke. - M.: Academy, 2008 .-- 352 p. 3. Pugachev I.N. Organization of the movement of automobile transport in cities: textbook. The allowance / I.N. Pugachev. - Khabarovsk: Publishing House of the Pacific State. Univ., 2005 .-- 196 p. 4. Pugachev I.N. Organization and traffic safety: a training manual / I.N. Pugachev, E.M. Oleschenko, A.E. Grief. - M.: Academy, 2009 .-- 272 p. 5. Polischuk V.P. Theory of traffic flow: methods and models of organizing road ruch: nav. Pos_b / V.P. Polischuk, O.P. Dziuba. - K .: Knowledge of Ukraine, 2008 .-- 175 p. 6. Dmitrichenko M.F. Systemology on transport IV: Organization of the road rukh / E.V. Gavrilov, M.F. Dmitrichenko, V.K. Share that. - K .: Knowledge of Ukraine, 2005 .-- 452 p. 7. Organization and regulation of the road rukhu: pidruchnik / zag. ed. V.P. Polishchuk; O. O. Bakulich, O. P. Dzyuba, V. I. Єresov that ін. - K .: Knowledge of Ukraine, 2011 .-- 467 p.
Support tools	*PTV Visum* *MS Office*

3.3.3 Employment opportunities

Graduates who hold a Master's degree in smart transport and logistics for cities (Transport Technology (in motor transport)) may have the following professional titles (according to Ukrainian encoding):

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

Graduates will be able to hold the following positions:

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

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

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

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

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

3.3.4 Prerequisites (Admission procedure):

A first (Bachelor's) degree or educational qualification level of the specialist. The procedure for admission to the Master's degree is based on the student's rating and examination. The dates of the admission procedure are from July to August each year.

3.3.5 Cycle / Level

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

3.3.6 Teaching and learning

Lectures, laboratory work, practical training, individual work based on textbooks, tutorials and lecture notes, consultations with teachers, seminars, demonstration classes, elements of distance (on-line, electronic) training of passing of practice at profile enterprises and in research institutions, performance of scientific research, traineeship, preparation of master's qualification work.

The Department of Automobiles and Transport Technologies owns the "Traffic flow modeling" Laboratory, which students use during their studies.

The scientific component of the educational-professional programme involves conducting one's own master's scientific research under the guidance of a scientific supervisor. The results are issued in the form of a master's qualification work.

An integral part of this programme`s scientific component is the preparation and publication of scientific articles, talks at scientific conferences, scientific workshops, round tables and symposiums.

3.3.7 Evaluation

Cumulative points-rating system which evaluates students for all types of classroom and extracurricular study and research activities, aimed at acquisition of the academic workload from the educational-professional programme: continuous assessment, laboratory reports, oral presentations, course project presentations, written and oral exams and final tests, exams from special courses of scientific research in the specialty, final tests from scientific research and practice, educational-professional practice and practice on the subject of the master's qualification work, presentation of the master's qualification work.

3.3.8 Personnel support

Training of masters of the specialty SmaLog (275 Transport technologies (on motor transport)) - is provided by the Automobiles and Transport Technologies Department of the Zhytomyr Polytechnic State University.

In all, 14 lecturers in the department of transport technologies hold lectures, practical and laboratory classes.

The structure of the personnel, the system of selection, use, advanced training, the dynamics of the composition of scientific and teaching staff is sufficient to ensure the quality training of specialists at the educational and qualification level of the master's degree programme.

3.3.9 Internship

Internship for students consists of two types:

1. Scientific practice;
2. Practice on the topic of the master's work.

A student can practise, for example:

- in research institutions;
- at the departments of the university;
- in transport companies;
- in public or private institutions;
- in colleges and vocational schools.

The plan of design and experimental work of the student is approved by the head of department. After completing the practice, the student must pass the assessment of the preparation and undergo a test, which is conducted at the department.

3.4 Equipment and materials

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

- computers, software packages and peripheral 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 work;
- teaching materials which is up-to-date and supports Master/PhD students training;
- special software which has been revised to improve the quality of SmaLog training.

Table 18 – Equipment available for SmaLog students

№	Group of Equipment	Elements	System Parameters	Quantity
1.	Computers	1.System Boxes (Type A)	***Processor*** - AMD Ryzen 5 2600, 6-core, 12 threads, Clock Speed 3.4 GHz, Socket AM4. ***Motherboard*** - Asus Prime b350-plus. ***Memory ram*** - DDR4, 16GB, 2400 MHz. ***HDD*** - Seagate 3.5" 1TB ***SSD*** - Western Digital 2.5" 240GB ***Graphic Card*** - GeForce *GTX1050 Ti 4096Mb ASUS* ***Box*** - Vinga Apache-500W	10
		2.Keyboards-Mice completes	SVEN Standard 300 Combo, black, USB	13
		3. Mice	NX-7000 Blacк	3
		4. Computer Monitors	Dell P2417H Black, 23.8", 1920x1080	14
		5.System Boxes (Type B)	***Processor*** - Intel Core™ i5 7500, 4-core, Clock Speed 3.4 GHz, Socket 1151. ***Motherboard*** - ASUS H110M-K ***Memory ram*** - DDR4, 16GB, 2400 MHz. ***HDD*** - Seagate 3.5" 1TB ***SSD*** - Western Digital 2.5" 250GB	3

			Graphic Card - GeForce *GTX1050 Ti 4096Mb ASUS* ***Box*** - Vinga Apache-500W	
		6. Laptops (Type A)	Acer Aspire 5 A515-51G-83S5, 15.6", Intel Core i7 8550U, DDR4	2
		7. Laptops (Type B)	ProBook 430 G5,13.3", Intel Core i5 8250U, DDR4	1
2.	Multimedia equipment	Projector VIEWSONIC, TV set Philips, Video adapter QUADRO P2200, SIGMA lens 16mm F1.4 DC DN, SONY lens 50mm F1.8 NEX FF		
3.	Technical training	1. Quadcopter	DJI Mavic 2 Pro with Set of accessories DJI Mavic 2 Enterprise Fly More Kit	1
		2. Professional digital sound level meter	Voltcraft SL-451	1
		3. Gas analyzer for cars	Optima 7-NDIR	1
		4. Motion detector	GNOM-DP	2
		5. Fuel flow sensor	Eurosens Delta PN250	1
		6. Car Simulator	3-Monitor Lanos Car Simulator	1
		7. HDD	HDD 2.5" USB 2.0 TB Transcend StoreJet	2
		8. GPS modules	TeltonikaFMB 125	5
4.	Software	PTV Visum, ArcGIS, Adobe Creative Cloud, Mathcad, 3DSurvey, AutoCAD Civil 3D, КОМПАС-3D		
5.	Peripherals	1.Multi-functional device	Canon i-Sensys MF643Cdw	2
6.	Books	- Urban Transportation and Logistics: Health, Safety, and Security Concerns; - Public Transit Planning and Operation: Modeling, Practice and Behavior, Second Edition; - Modeling Intelligent Multi-Modal Transit Systems; - Transportation Systems Analysis.		

4 Conclusions

With regard to the provision of training of highly qualified specialists in specialty 275 “Transport technologies”, the specialization “Smart transport and logistics for cities” is able to implement smart transport into city transport systems, make decisions on development of transport systems and logistics in cities, on the impact of persons on the safety and stability of city logistics, and estimate the effectiveness of city transport systems and also prepare students for further employment in their chosen specialty.

The educational-professional programme is based on input from state-of-the-art knowledge in smart transport and logistics in cities, urban passenger transport, traffic flow simulation, road traffic management, freight transportation, management of traffic flows in city centres, impact of persons and the environment on safety and stability of city logistics and also the effectiveness of city transport systems that add to the participants’ professional skills and provide the framework for advancing their professional and scientific careers.