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Master in SMArt transport and LOGistics for cities / SMALOG

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Master Curricula

development and implementation

at Zhytomyr Polytechnic State University - ZPSU

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Summary: 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 curricula 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 have been built. The deliverable provides the structure in term of modules, the expected learning outcomes, the references publications and the needed materials in order to deliver the Master.

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Master in SMArt transport and LOGistics for cities
SMALOG

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1   Introduction

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

The consortium is composed of four EU universities, four Ukraine and two Georgian universities, and one institute of advanced studies. The EU Universities are: 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 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 at transferring 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 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 one hand, there is a need to clearly understand local conditions and needs both in terms of research and teaching on such a topic. On the other hand, 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 carried out analysis highlighted 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 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 previous recalled results, the new Master 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 par with the European Area of Higher Education.

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

all, while Master on Transport topics are already available in Ukraine and Georgia there is not a 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 Master courses. In some Masters, there are no practical or laboratory activities whatsoever, whilst in other courses they are not extensive and need to be improved.

To avoid administrative barriers, some local academics suggest revising/extending an existing Master programme rather than setting up a new Master programme. This is a relevant opportunity since it will allow the delivery of the Master since the second year of the project and to capture more in depth the local needs 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 deliverable whose main objective is the definition of 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, Programmes structure and Equipment and material. The last section, Chapter 4, presents conclusions.

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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 meeting carried out during application design and first months after 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 new Masters Programme will be mainly defined accordingly 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 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 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 the last years.

Recommendations highlight a problem related to the low level of technical equipment and reference material in the current laboratories in term 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 system. For this reason, the Masters curricula will include practical activities, laboratory activities and field

activities. Moreover, the final thesis, foreseen 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 high qualified specialists in specialty 275 "Transport technologies", specialization "Smart transport and logistics for cities" able to:

- implement smart transport into city transport systems,
- make decisions on 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 chosen specialty, 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. Educational-professional program is based on results of modern knowledge in smart transport and logistics in cities, urban passenger transport, traffic flows simulation, road traffic management, freight transportation, management of traffic flows in city centers, impact of persons and environment on safety and stability of city logistics and also the effectiveness of city transport systems that deepens professional outlook and provides the framework for further professional and scientific career.

Educational-professional has four professional lines: passenger transportation in cities; freight transportation and logistics in cities; traffic flows management; smart transport.

3   SmaLog at Zhytomyr Polytechnic State University

3.1   Master objectives and profile of the Master graduates

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

3.2   Programme structure

Educational-professional program "Smart transport and logistics for cities" of the second cycle of higher education, specialty 275 Transport Technologies, branch of knowledge 27 Transport, qualification "Master" program lasts one and half year for a total of 90 ECTS. According to the Law of Ukraine "On Education" and the Order of Ministry of Education and Science of Ukraine 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 semesters				ECTS number	Number of hours								Distribution of hours by years of study and semesters		
		Qualification Exams	Tests	Coursework			Together	Auditory					Individual work		1 Year		2 Year
				Projects	Course Papers			Total	included:						Semesters		
									Lectures	Practical classes	Labs				1	2	3
															Number of weeks per semester		
															16	16	0
1. General training cycle																	
1.1. Obligatory components																	
1.1.1.	Foreign language professional direction	1				5	150	48		48		102	68%		3		
1.1.2.	Methodology and organization of research and copyright protection	2				4	120	48	16	32		72	60%			3	
	Intellectual property		2			3	90	32	16	16		58	64%			2	
1.1.3.	Philosophical problems of scientific knowledge	1				3	90	32	16	16		58	64%		2		
ZP1.02	Economic efficiency of cities transport systems		2			3	90	32	16	16		58	64%			2	
	Total:					18	540	192	64	128	0	348	3,2		5	7	0

Code	Course					ECTS	Hours						%			
2. Cycle of professional training																
2.1. Obligatory components																
PP2.02	Public passenger transport	2				4	120	64	32	32		56	47%		4	
ZP1.06	Smart transport and logistics for cities	1			1	4	120	48	16	32		72	60%	3		
ZP1.07	High-speed bus transportation		1			3	90	32	16	16		58	64%	2		
PP2.05	Human and environmental impact on the cities logistics, safety and stability		1			4	120	64	32	32		56	47%	4		
PP2.06	Social efficiency of urban transport systems	2				3	90	32	16	16		58	64%		2	
2.1.1. Practical training																
	Pre-diploma practical training		3			9	270									
	Research scientific training		3			6	180									
	Diploma	3				15	450									
	Total:					48	1440	240	112	128	0	300	2,826	9	6	0
2.2. Selective components																
(The student should choose 24 ECTS based on the weekly workload)																
PP2.11	Traffic flows modeling	2		2		4	120	48	16	16	16	72	60%		3	
PP2.12	Smart transport		2			4	120	48	16	32		72	60%		3	
PP2.13	Freight transportation modeling		2			4	120	48	16	16	16	72	60%		3	
PP2.14	Traffic management in the city centers		1			4	120	48	16	32		72	60%	3		
PP2.17	Road traffic management	1				4	120	48	16	32		72	60%	3		
PP2.22	Intelligent transport systems		1			4	120	48	16	16	16	72	60%	3		
PP2.23	Special methods of traffic management		2			4	120	48	16	32		72	60%		3	
PP2.24	Freight transport systems	2		2		4	120	48	16	16	16	72	60%		3	

Code	Name						ECTS	Total						%			
PP2.25	Transportation planning of big cities		2				4	120	48	16	16	16	72	60%		3	
PP2.26	Automated traffic control systems		1				4	120	48	16	32		72	60%	3		
	Geo-information systems		1				4	120	48	16	16	16	72	60%	3		
PP2.30	Supply chain management	1					4	120	48	16	32		72	60%	3		
	Total:						**24**	**720**	**288**	**96**	**144**	**48**	**432**	**3,6**	**9**	**9**	**0**
	TOTAL OF THE PROFESSIONAL TRAINING CYCLE:						72	2160	528	208	272	48	1632	76%	18	15	0
	TOTAL:						**90**	**2700**	**720**	**272**	**400**	**48**	**1980**	**73%**			
	Hours per week														**23**	**22**	**0**
	Number of Exams													**8**	**4**	**4**	
	Number of Tests													**8**	**4**	**4**	
	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 to the obligatory part.

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

Code	Components of the educational program (training courses, course papers, practical trainings, qualification work)	ECTS credits	Form of final control
1	2	3	4
Mandatory components:			
MC1	Foreign language professional direction	5	Exam
MC2	Methodology and organization of research and copyright protection	4	Exam
MC3	Intellectual property	3	Test
MC4	Philosophical problems of scientific knowledge	3	Exam
MC5	Economic efficiency of cities transport systems	3	Test
MC6	Public passenger transport	4	Exam
MC7	High-speed bus transportation	3	Test
MC8	Smart transport and logistics for cities	4	Exam Course paper
MC9	Human and environmental impact on the cities logistics, safety and stability	4	Test
MC10	Social efficiency of urban transport systems	3	Exam
MC11	Pre-diploma practical training	9	Test
MC12	Research scientific training	6	Test
MC13	Diploma	15	
Total amount of mandatory components:		**66**	

3.2.2 Elective part

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

Table 3 – Modules of the project which are included to the elective part

Code	Components of the educational program (training courses, course papers, practical trainings, qualification work)	ECTS credits	Form of final control
SC1	Traffic flows modeling	4	Exam Course paper
SC2	Smart transport	4	Test
SC3	Freight transportation modeling	4	Test
SC4	Traffic management in the city centers	4	Test
SC5	Road traffic management	4	Exam
SC6	Intelligent Transport Systems	4	Test
SC7	Special methods of traffic management	4	Test
SC8	Freight transport systems	4	Exam Course paper
SC9	Transportation planning of big cities	4	Test
SC10	Automated traffic control systems	4	Test
SC11	Geo-Information Systems	4	Test
SC12	Supply Chain Management	4	Exam
Total amount:		**24**	

To obtain the master degree the student has to obtain 90 ECTS. More details can be find on the
https://vstup.ztu.edu.ua/magistr/275-transportni-tehnologiyi-na-avtomobilnomu-transporti/

Table 4 - Structural and logical scheme of the educational program

Code	Components of the educational program (training courses, course papers, practical trainings, qualification work)	Credits ICTS	Total hours	Summative assessment form
1	2	3	4	3
I year, I semester				
MC1	Foreign language professional direction	5	150	Exam
MC4	Philosophical problems of scientific knowledge	3	90	Exam
MC8	Smart transport and logistics for cities	4	120	Exam Course paper
MC7	High-speed bus transportation	3	90	Test
MC9	Human and environmental impact on the cities logistics, safety and stability	4	120	Test
Courses of the block 1				
SC4	Traffic management in the city centers	4	120	Test
SC5	Road traffic management	4	120	Exam
SC6	Intelligent Transport Systems	4	120	Test
Courses of the block 2				
SC10	Automated traffic control systems	4	120	Test
SC11	Geo-Information Systems	4	120	Test
SC12	Supply Chain Management	4	120	Exam
I year, II semester				
MC2	Methodology and organization of research and copyright	4	120	Exam
MC3	Intellectual Property	3	90	Test
MC5	Economic efficiency of cities transport systems	3	90	Test
MC6	Public passenger transport	4	120	Exam
MC10	Social efficiency of urban transport systems	3	90	Exam
Courses of the block 1				
SC1	Traffic flows modeling	4	120	Exam Course paper
SC2	Smart transport	4	120	Test
SC3	Freight transportation modeling	4	120	Test
Courses of the block 2				
SC7	Special methods of traffic management	4	120	Test
SC8	Freight transport systems	4	120	Exam Course paper
SC9	Transportation planning of big cities	4	120	Test
II year, I semester				
MC11	Pre-diploma practical training	9	270	
MC12	Research scientific training	6	180	
MC13	Diploma	15	450	
	Total amount:	**90**	**2700**	

3.3   Educational objectives

3.3.1   Program competencies

Integral competence:

Ability to solve complex tasks and problems in certain branch of professional activity or in study process which provides 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 national (international) group projects on operations improvement on transport.
- Ability to organize the group work and also motivate and manage its work.
- Ability to searching, processing and analyzing information from different sources with the help of modern informational and communication technologies.
- Ability to determine economic factors and provide the quality of conducting operations during the development and realization of complex actions and projects in compliance with the conditions of work, regulations of civil defense and environmental protection.
- Ability to communicate with professional and general audience, present information in oral, printed or other forms in native of foreign language on professional level.
- Ability to use in practice different theories in the field of study, effectively using general pedagogical concepts.

- Ability to pursue research within 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 the supply chains and logistic centers.

- Ability to manage the freight transportation by means of transport.

- Ability to manage the 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 conduct an assessment of transport systems in city infrastructure.

- Ability to operate traffic flows in cities.

- Ability to operate the movement on sections of transport network.

- 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 perform the designing of systems of smart transport and logistics in cities.

- Ability to conduct an assessment of reliability and safety of city logistics.

- Ability to research the psychology of movement and the influence of a person on transport system reliability.

- Ability to research and manage the traffic flows in city centers.

- Ability to determine the effectiveness of city transport systems.

- Ability to determine the influence of transport on environment.

For special (professional, subject) competencies:

- Improvement of approaches and methods for research and management of functioning of the integrated transport systems.

- Justification of reasonability of measures for transport technologies improvement with the use of transport processes simulation. Conduct an assessment of effectiveness of chosen measures.

- Justification of the reasonability of implementation of modern technologies of freight forwarding service.

- Improvement of the approaches and methods for conducting the commercial, technical, social, ecological, institutional, financial and economic analysis during development innovative and investment projects.

- Analysis and justification of the implementation of the modern methods, to have the ability to conduct an analysis and calculation of economic operating rates of supply chains and logistic centres.

- Use of the informational resources for improving the supply chain modeling.

- Elaboration of measures for management of freight transportation using simulation of processes of freight transportation by means of transport.

- Elaboration of the measures for management of 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 methods of transport processes research.
- To simulate material and transport flows.
- To find optimal solutions of application of 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 transport services market.

- To estimate the influence of people and environment on the safety and stability of city logistics.

Communication:

- Ability to communicate including oral and written communication in Ukrainian language and at least one of the common foreign languages;

- Ability to carry out explanatory and awareness-building work among different groups and segments of population with the aim of using the smart transport and logistics in cities;

- Ability to describe the results of scientific research on smart transport and logistics in publications in national and foreign specialized publications.

Autonomy and responsibility:

- Ability to adapt to new situations and make decisions on its 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 the ongoing work and achieve the set aim with the adherence to the requirements of professional ethics.

3.3.2 Modules

The Tables below report the modules of SmaLog degree.

Table 5 – Professional modules of Master programme

Module	
Economic efficiency of cities transport systems	Table 6
Public passenger transport	Table 7
Smart transport and logistics for cities	Table 8
Traffic flows modeling	Table 9
Intelligent transport systems	Table 10
Traffic management in the city centers	Table 11
Human and environmental impact on the cities logistics, safety and stability	Table 12
Social efficiency of urban transport systems	Table 13
Supply chain management	Table 14
Automated traffic control systems	Table 15
Freight transportation modeling	Table 16
Special methods of traffic management	Table 17

Table 6 – Economic efficiency of cities transport systems

Title	Economic efficiency of cities transport systems
Number of ECTS	3 ECTS
Year and semester	1st year, 2nd semester
Lecturer	Associate Professor Vitalii Kuchmenko
Teaching method	Classroom teaching
Examination procedure	Written and Oral
Project foreseen	Individual project
Aim	To obtain the knowledge and skills regarding smart transportation and logistics for cities. Objective: to define the challenges in urban transportation system namely passenger transportation, freight transportation, traffic taking into consideration intelligent transportation system and new technologies. Competences: to analyze and justify modern techniques concerning transportation process in the cities; etc. Learning outcomes: improvement of approaches and methods for research and control of the operation of the integrated transport systems in the cities namely freight, passenger transportation; etc.
Contents	Effective pricing policy. Factors affecting the demand for transportation. Weighted tariff system. Improvement of transport system infrastructure. Improving the quality of public transport. Investment attractiveness of public transport. Scripts of development of transport systems.
Text book	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
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, 2nd semester
Lecturer	Associate Professor Andrii Ilchenko
Teaching method	Classroom teaching
Examination procedure	Written and Oral
Project foreseen	Individual project
Aim	To acquire the knowledge concerning methods of formation and modeling of city passenger flows, assessment of quality of functioning of city transport systems (PTV Vision) Methods of modeling urban passenger correspondence using software products PTV Vision. 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 management of passenger transportation by types of transport; - simulation of route systems.
Contents	**Passenger Transportation Management** Strategies for demand management for transport services. Models of transport demand. Coordination of various types of public transport using VISSUM. Distribution of trips by type of transport and analysis of the choice of the mode of transport. Factors influencing the performance of urban passenger transport. Customize individual vehicle redistribution options in VISSUM. Manage the route. 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 psychophysiological state of the passenger. 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 modeling urban passenger correspondence using software products PTV Vision. Optimization models of city transport system formation. Determination of passenger travel time in the route system using PTV Vision. Methodology for assessing the quality of functioning of city transport systems.
Text book	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 foreseen	Individual project
Aim	1. Improving approaches and methods for studying and managing the operation of smart transport systems. 2. To analyze and substantiate the application of modern methods, have the ability to analyze and calculate the economic performance of the chain of supply and logistics centers. 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. 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.
Text book	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).
Support tools	PTV Visum Pupil world camera Regression analysis Analysis methods Mobile Mapping Systems MS Office (Excel, Word, PowerPoint)

Table 9 – Traffic flows modeling

Title	Traffic flows modeling
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 foreseen	Individual project
Aim	• Ability to organize the group work and also motivate and manage its work. • Ability to searching, processing and analyzing information from different sources with the help of modern informational and communication technologies. • Ability to communicate with professional and general audience, present information in oral, printed or other forms in native of foreign language on professional level. • Ability to use in practice different theories in the field of study, effectively using general pedagogical concepts. • Ability to pursue research within 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 sections of transport network. • Ability to simulate route systems. • Ability to use information technologies in traffic flow management. • Ability to perform the designing of systems of smart transport and logistics in cities.
Contents	While studying this discipline, the student acquires theoretical and practical knowledge and skills in developing of organizing traffic flows schemes, including: regulated and unregulated intersections. It`s based on the results of laboratory work and course project, conducting individual studies on modeling these processes on computers. It discusses in detail the various modeling options using the PTV software product and defines the main indicators of the traffic flow efficiency of the intersection. The whole complex of such information meets the requirements of current norms, standards and methods of traffic safety organization.
Text book	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 transportnыx 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 slozhnыx sy`stem / N.P.Buslenko.-M.: Nauka,1968.-435 s. 8. Sy`l`yanov V.V. Teory`ya transportnыx 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 transportnыx 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 observation Synthesis of domestic and foreign information sources Radars for traffic data collection

Table 10 – Intelligent transport systems

Title	Intelligent transport systems
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 foreseen	Individual project
Aim	1. To simulate multimodal transport networks; 2. To make forecasting of state variables and behaviour of transport networks users; 3. To simulate multimodal transport networks in real time; 4. To support users in the multimodal network; 5. To design and manage multimodal intelligent transport systems operatively;

	6. Improve the parameters of the demand and supply model.
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 center. Real-time transport network forecasting. Specification, calibration and testing of ITS models. Examples of application of ITS models.
Text book	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 the city centers

Title	Traffic management in the city centers
Number of ECTS	4 ECTS
Year and semester	1st year, 1st 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 the parameters of traffic; 4. To choose the 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 traffic control at a separate intersection. Adjustment by phases (steps). Adjustment by signaling groups. Adaptive software control. Coordinated traffic control. Parameters of the coordination program 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 on regulated and unregulated areas. Light traffic control taking into account the characteristics of pedestrian streams. Organization of pedestrian traffic and underground pedestrian traffic. Information systems for pedestrians. Securing the pedestrian movement Organization of cycling on the lines of traffic and intersections. Light traffic control with regard to cycling. Organization of parking places for bicycles. Information system for cyclists. Ensuring the safety of cycling. Arrangement of ramps at crossroads, over ground and underground pedestrian crossings. Sound signals at regulated intersections. Use of tactile signals on sidewalks, intersections and stops of public transport. Transport traffic management on the city streets through the TRANSYT method. Automated centralized intelligence systems (SCOOT, SCATS). Automated control systems with decentralized intelligence (MOTION). The appointment of intelligent transport systems and their hierarchy.

	Navigation systems. Subsystem of traffic control in dangerous situations. Subsystem of informational support of 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 underground and above ground parking. Planning characteristics of parking lots. Schemes of car placement. Determine the number of cars and the area of one car on the parking lot. Width of fares. Radius of turns. Maneuvering zones
	Payment methods for using a car park. Design zones of paid parking. Parking facilities. Parking and parking features like "Park and Ride". Park and Ride parking management system. Technical subsystems of parking "Park and Ride" type.
	Features of the organization of parking in the city center. The ratio of the level of motorization and the number of parking places. Definition of the area and type of parking in the city center.
	Capacity of multi-level parking in central cities. 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 collection and processing of information on toxic emissions of transport flows. Subsystem of organization of traffic and traffic taking into account the requirements of environmental protection.
Text book	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, 1st 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 modeling 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.
Text book	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 transportnыx 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.

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Table 13 – Social efficiency of urban transport systems

Title	Social efficiency of urban transport systems
Number of ECTS	3 ECTS
Year and semester	1st year, 2nd semester
Lecturer	Associate Professor Vitalii Kuchmenko
Teaching method	Classroom teaching
Examination procedure	Written and Oral
Project foreseen	Individual project
Aim	The purpose of the course "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 and methods of organizing passenger transportation of socially protected population groups. The objective of the discipline "Social Efficiency of Urban Transport Systems" - 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	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 the route 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 regulation 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.
Text book	1. 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. 2. The share of VK Passenger transportation: A textbook. - Kharkov: View Fort, 2011. - 504 p. 3. Kristopchuk ME Suburban passenger transportation: a textbook / [M.E. Kristopchuk, OO Lobashov] - X .: NTMT, 2012. - 224p. 4. 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. 5. Davidich Yu.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. 6. 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. 7. Passenger road transportation: VA Gudkov, L.B. Mirotin, A.V. Grandmaster. M .: Hotline - Telecom, 2006. - 448 p.
Support tools	MS Office (Excel, Word, PowerPoint)

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Table 14 – Supply chain management

Title	Supply chain management
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 foreseen	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 includes 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 includes 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
Text book	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)

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Table 15 – Automated traffic control systems

Title	Automated traffic control systems
Number of ECTS	4 ECTS
Year and semester	1st year, 1st semester
Lecturer	Associate Professor Dmytro Beherskyi
Teaching method	Classroom teaching
Examination procedure	Written and Oral
Project foreseen	Individual project
Aim	To obtain the knowledge and skills regarding smart transport. Objective: to define the challenges in urban transportation system namely passenger transportation, freight transportation, traffic taking into consideration intelligent transportation system and new technologies. Competences: to analyze and justify modern techniques concerning transportation process in the cities. Learning outcomes: improvement of approaches and methods for research and control of the operation of the integrated transport systems in the cities namely freight, passenger transportation; etc
Contents of part 1 Information Technologies in Traffic Managements	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. Centers traffic management. Road traffic control Systems control speed road traffic, 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 the road network. Control and guide for drivers Road signs, road surface marking, 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. 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 of vehicle traffic parameters by satellite navigation.

	Transport management using satellite navigation systems Features of application of navigation systems on transport. Features of navigation systems. Information support for navigation systems. Control of the operation of transport using navigation systems. Selection of traffic routes. Simulation of transport parameters by means of satellite navigation systems.
Text book	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 16 – Freight transportation modeling

Title	Freight transportation modeling
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 foreseen	Individual project
Aim	1. Improving approaches and methods for research and management of the operation of integrated transport systems. 2. Justification of feasibility of measures for improvement of 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 transportations. 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 the management of freight traffic.
Contents	Urgency of modeling of processes of freight transportations. Cargo and cargo turnover. Features of freight transportation. Modeling 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. Modeling of freight traffic in international traffic. Organization and management of main and centralized cargo transportation. Transport safety.
Text book	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 17 – Special methods of traffic management

Title	Special methods of traffic management
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 foreseen	Individual project
Aim	To obtain the knowledge and skills regarding the Special methods of traffic management. **Competence** Ability to research and manage of Special methods of traffic management. **Learning outcomes** After study the course the students will be able: ✓ *technological* - by scientific formation of measures and requirements for solving traffic safety problems in order to improve it and eliminate the concentration of road accidents on public roads, railroad crossings and streets of settlements by improving the ones 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 conditions of interaction of road conditions and traffic flows and conditions of 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 deployments to ensure a high level of road safety;

	✓ **control** - through scientific justification of traffic control on the network of public roads, railway crossings and streets of settlements and the use of normative documentation and records obtained in commission surveys, improving road maintenance and road network 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 hard-weather conditions. Theme 4. Developing measures to ensure the organization of safe pedestrian motion. Topic 5. Organization of road movement on transport networks. Theme 6. Dynamic organization of transport. Specific problems for regulating movement in cities and towns.
Text book	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 iн. - K .: Knowledge of Ukraine, 2011 .-- 467 p.
Support tools	*PTV Visum* *MS Office*

3.3.3 Employment opportunities

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

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

Graduates will be able to hold the following positions:

- Engineer in management and organization of transportation (II category);
- Transport engineer at transport enterprises, in the management of public and passenger transport, transport and communications management of the region, district and city administration, in research laboratories of design institutes and institutes of forensic examinations, in transport and forwarding enterprises;
- Engineer in employee training and retraining departments;
- Teacher of 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):

Presence of the first (Bachelor) degree or educational qualification level of the specialist. The procedure for admission to Master degree based on the students rating and examination. The dates of admission procedure from July to August.

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 works, practical trainings, individual work based on textbooks, tutorials and lecture notes, consultations with teachers, scientific 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, prepare of master qualification work.

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

The scientific component of the educational-professional program involves conducting the 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 program`s scientific component is the preparation and publication of scientific articles, speeches at scientific conferences, scientific workshops, roundtables, symposiums.

3.3.7 Evaluation

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

The total number of lecturers in the department of transport technologies, which hold lectures, practical and laboratory classes - 14 persons.

The structure of the personnel, the system of selection, use, advanced training, the dynamics of the composition of scientific and pedagogical staff is sufficient to ensure the qualitative training of specialists in the educational and qualification level of the master.

3.3.9 Internship

Internship for students consists of two types:

1. Scientific practice;

2. Practice on the topic of master's work.

A student can practice, 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.

After completing the practice, the student must pass the assessment of the preparation and make a test, which is conducted at the 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.

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 Black	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 *Graphic Card* - GeForce *GTX1050 Ti 4096Mb ASUS* *Box* - Vinga Apache-500W	3
		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	BenQ Siemens (Мультимедийный проектор)		
3.	Technical training	1. Quadcopter	DJI Mavic 2 Pro with Set of accessories DJI Mavic 2 Enterprise Fly More Kit	1
4.	Software	PTV Visum, AutoCAD Civil 3D, КОМПАС-3D		
5.	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

Provision of training of high qualified specialists in specialty 275 "Transport technologies", specialization "Smart transport and logistics for cities" able to implement smart transport into city transport systems, make decisions on development of transport systems and logistics in cities, impact of persons on safety and stability of city logistics and estimate the effectiveness of city transport systems and also prepare students for further employment in chosen specialty.

Educational-professional program is based on results of modern knowledge in smart transport and logistics in cities, urban passenger transport, traffic flows simulation, road traffic management, freight transportation, management of traffic flows in city centers, impact of persons and environment on safety and stability of city logistics and also the effectiveness of city transport systems that deepens professional outlook and provides the framework for further professional and scientific career.