

SYLLABUS

Teacher					
Course	Models and Algorithms for Logistics and Transport				
Module	Compulsory subjects	ECTS	5	Course code	23SM.P.LA.22

Major	Speciality	Academic year	
LOGISTICS	Industrial systems engineering	2023/2024	
Semester	Fourth	Year of studies	Second

Type of studies	Full-time				Extramural			
Type of classes	Lecture	Exercise	Laboratories	Project	Lecture	Exercise	Laboratories	Project
Amount of hours	30	10	20					
TOTAL	60							

Course objectives	<p>Upon completion of this course, student will be able to: Formulate a real-world problem as a mathematical programming model, implement and solve the model in EXCEL, understand the theoretical workings of the simplex method for linear programming and perform iterations of it by hand, Perform sensitivity analysis to determine the direction and magnitude of change of a model's optimal solution as the data change, Solve specialized linear programming problems like the transportation and assignment problems, solve network models like the shortest path, minimum spanning tree, and maximum flow problems, understand how to model and solve problems using dynamic programming</p>
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Minimum knowledge required from the student before the classes beginning	Familiarity with linear algebra is required
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Recommended literature to study before the classes beginning	Meckes E.S., Meckes M.W., <i>Linear Algebra</i> 1st Edition, Cambridge Mathematical Textbooks, 2018
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LEARNING OUTCOMES		KEK	METHODS OF ASSESSMENT		
KNOWLEDGE	K01	Utilize ability apply the theoretical knowledge to use appropriate management tools to model of selected transport and logistics processes in the enterprise	K2_W04_L_P	EM5 EM9	Written examination with practical tasks (computational or drawing tasks). Written test with computational tasks
	K02	Explain and apply methods of math analysis of the company and its environment	K2_W02_L_P	EM1 EM9	Oral exam. Written test with computational tasks
	K03	Explain and apply proficiently modern methods and tools of logistic and transport management. Explain the relationships and dependencies between logistics and other functional areas of the company, also in the international scale	K2_W03_L_P	EM1 EM9	Oral exam. Written test with computational tasks
	K04	Explain the essence of the logistics service, including the conditions and principles of marketing management of logistics services and proficiently identify and describe the essence of logistics in crisis situations	K2_W06_L_P K2_W07_L_P	EM1 EM15	Oral exam. Evaluation of activity in the class-room
SKILLS	S01	Utilize integrated knowledge from various logistics fields, as well as to select appropriate methods and tools for identify, interpret, describe and analyse problems and areas of logistics and its conditions	K2_U01_L_P	EM1 EM10	Oral exam. Written test in the form of open tasks. Project evaluation
	S02	Demonstrate proficiency to initiate and manage logistics projects using IT tools. Utilize ability to formulate and present in English the general and functional strategies for enterprises and logistics services on the domestic and international market	K2_U03_L_P K2_U09_L_P	EM10 EM15	Project evaluation Evaluation of activity in the class-room

	S03	Student gather the basic skill in the area of database design and implementation	K2_U04_L_P K2_U09_L_P	EM1 EM8	Oral exam. Written test in the form of open tasks
	S04				
SOCIAL COMPETENCE	SC01	Demonstrate proficiency to identify and resolve dilemmas related to the profession; is aware of the importance of acting in a professional manner and also follow the rules of professional ethics	K2_K02_L_P	EM16	Assessment of the work, students co-operation in the classroom
	SC02	Utilize ability to think and act in an entrepreneurial way and is prepared to create and organize economic projects	K2_K02_L_P	EM15 EM16	Evaluation of activity in the lab. Project evaluation Evaluation of activity in the classroom
	SC03	Demonstrate proficiency to cooperate for the preparation of economic projects, taking into account legal, economic and technical aspects and understand the effects of the actions taken, including their impact on the environment and the related responsibility for the decisions made.	K2_K05_L_P	EM15 EM16	Evaluation of activity in the lab. Project evaluation Evaluation of activity in the classroom

Course contents	Lecture & Exercise	<ul style="list-style-type: none"> • Topic Time Introduction • Optimization Models and Examples • Linear Programming • Linear Programming Models • Graphical Solution • Simplex Algorithm and Goal Programming • Sensitivity Analysis and Duality • Transportation Models • Network Models and Algorithms • Integer Programming • Modelling with integer variables • Branch and Bound Methods • Dynamic Programming • Queueing Models • Nonlinear Programming • Nonlinear Models • KKT conditions
	Exercises	The student is required to read the application document for linear programming and write a report on the subject. Students receive linear programming tasks related to "real" examples in the field of logistics, transport, storage (queues), etc. After getting to know the task the student must build a model of criterion function and constraints conditions and then solve the task using the available OR tools in the project. Details of the project guidelines will be provided by the lecturer in a separate instruction
	Laboratories & project	<ul style="list-style-type: none"> • tasks related to the construction and solving of linear programming models • solving linear programming tasks using the graphical method, primal and dual programming, integer programming • Simplex Algorithm and Goal Programming • solving linear programming tasks using a transport model (time criterion and cost criterion) • Modelling with integer variables using MS EXCEL • Branch and Bound Methods • Dynamic Programming • Queueing Models • Nonlinear Programming • Nonlinear Models • KKT conditions

Teaching methods	TM2 TM11	A lecture with a multimedia presentation, topic-related films, discussions
	TM14	Laboratories – experiment and laboratory analysis
	TM8	Project method

Obligatory literature	1	Hillier F.S., Lieberman G.J., Introduction to Operations Research, McGraw-Hill Education, 2021
	2	Winston W.L., Operations Research: Applications and Algorithms, Cengage Learning, 2019
	3	Ahuja R.K., Magnanti T.L., Orlin J.B., Network Flows: Theory, Algorithms, and Applications, Pearson, 2017

Additional literature	1	Albright S.C., Winston W.L., Business Analytics: Data Analysis and Decision Making, Cengage Learning, 2020
	2	Cormen T.H., Leiserson C.E., Rivest R.L., Stein C., Introduction to Algorithms, MIT Press, 2022
	3	Ravindran A., Phillips D.T., Solberg J.J., Operations Research: Principles and Practice, Wiley, 2019

Requirements to pass the course

Exercises are evaluated on the basis of the student's activity during the classes and on the basis of a written colloquium.

The laboratory consists of practical classes that are assessed on an ongoing basis for the performance of the lecturer's instructions and for activity in the classroom. Students solve tasks individually and in teams.

The subject ends with an oral exam, which refers to the content presented at the lectures.

The share of each grade in the final evaluation in the part of the assessment is as follows: 50% oral exam, 30% laboratory grade, 20% exercise grade.

To obtain a satisfactory result of the exam, the student must get 50% of points from the basic sum.