THE INTERNATIONAL UNIVERSITY OF LOGISTICS AND TRANSPORT IN WROCLAW

SYLLABUS

Teacher					
Course	Operational research in warehouse management				
Module	Optional course	ECTS	4	Course code	23SM.P.L.B.IEP.3.2

Major	Speciality	Academic year
LOGISTICS	Industrial systems engineering	2023/2024

Semester	THIRD	Year of studies	SECOND

Type of studies	Full-time				Extramural			
Type of classes	Lecture	Exercise	Laboratories	Project	Lecture	Exercise	Laboratories	Project
Amount of hours	18	12	12					
TOTAL	42							

Course objectives	**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**

Minimum knowledge required from the student before the classes beginning
Familiarity with linear algebra is required

Recommended literature to study before the classes beginning
Meckes E.S., Meckes M.W., *Linear Algebra* 1st Edition, Cambridge Mathematical Textbooks, 2018

LEARNING OUTCOMES			KEK	METHODS OF ASSESSMENT	
KNOWLEDGE	K01	**Utilize ability apply the theoretical knowledge to use OR&O tools to model of selected linear 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	**Demonstrate proficiency in math management, including the principles of linear programming. 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 linear and nonlinear programming methods and tools of logistic 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				
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	• 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
	Project	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	• 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**	**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	

Additional literature	1	Gu J., Goetschalckx M., McGinnis L.F., Research on Warehouse Operation: A Comprehensive Review, European Journal of Operational Research, Elsevier, 2019
	2	
	3	

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.