UNDERGRADUATE STUDY: TRANSPORT

SEMESTER (V)

Syllabus

Academic year 2025/2026

Course:	**Basics of Simulations in Logistics**					
Head of course: Assoc. Prof. **Ratko Stanković**, Ph. D.						
Co-lecturers: Assist. Prof. **Diana Božić**, Ph. D.						
Semester: **V**	Course code: **133043**	Lectures: **30**	Auditory exercises: **0**	Laboratory exercises: **30**	Seminars: **0**	ECTS credits: **6**
Group for lectures: **18 students**			Group for auditory and laboratory exercises: **18 students**			

Objective of the course:

- Acquaint students with advantages and disadvantages of the simulation methods, the methodology of conducting simulation studies of logistic systems and processes, and ways of evaluating and presenting the results of simulation experiments. To apply the acquired knowledge in solving real logistic problems by using simulation software tools.

Course enrolment requirements:

None

Learning outcomes:

1. Select the level of abstraction of the real logistics system with regard to the purposeof the simulation study.
2. Analyse input data for creating simulation models of the logistics process.
3. Apply the basic principles of simulation modeling and implementation of a simulation experiment.
4. Design a simulation model of the logistics process and/or system, using a specialized software tool.
5. Evaluate the results of the simulation experiment.
6. Present the results of the simulation study.

LECTURES, EXERCISES and SEMINARS

Week	Syllabus	Form of classes	Performed by	Lessons	Remark
1.	▪ Basic concepts of models and simulation methods	L	Ratko Stanković		
	▪ Solving problem tasks - discrete distribution: delivery deadline exceeded, truck arrivals (Excel)	AE	Ratko Stanković		
2.	▪ Basic principles of simulation modelling	L	Ratko Stanković		
	▪ Solving problem tasks - discrete distribution: errors in picking, damages of goods (Excel)	AE	Ratko Stanković		
3.	▪ Application of simulation methods in logistics	L	Ratko Stanković		
	▪ Solving problem tasks - continuous distribution: delivery vehicle failures, intensity of arrivals (Excel)	AE	Ratko Stanković		
4.	▪ Random variables, random and pseudo-random numbers	L	Ratko Stanković		
	▪ Solving problem tasks - continuous distribution: duration of loading, mass of loaded cargo (Excel)	AE	Ratko Stanković		

5.	▪ Application of discrete probability distributions	L	Ratko Stanković		
	▪ Monte Carlo simulation: arrivals of trucks for unloadig goods, loading cargo into Tad wagons (Excel)	AE	Ratko Stanković		
6.	▪ Application of continuous probability distributions	L	Ratko Stanković		
	▪ Functionalities of the simulation software tools 1	AE	Ratko Stanković		
7.	▪ Monte Carlo simulation and simulation with discrete events	L	Ratko Stanković		
	▪ Simulation of the process of receiving goods (in the warehouse) 1	AE	Ratko Stanković		
8.	▪ Methodology of the simulation study	L	Ratko Stanković		
	▪ Simulation of the process of receiving goods (in the warehouse) 2	AE	Ratko Stanković		
9.	▪ Collection and analysis of input data	L	Ratko Stanković		
	▪ Simulation of the picking process 1	AE	Ratko Stanković		

10.	▪ Simulation software tools	L	Ratko Stanković		
	▪ Simulation of the picking process 2	AE	Ratko Stanković		
11.	▪ Designing simulation models	L	Ratko Stanković		
	▪ Functionality of the simulation software tools 2	AE	Ratko Stanković		
12.	▪ Implementation of the simulation experiment, analysis, and presentation of the results	L	Ratko Stanković		
	▪ Simulation of XD terminal 1	AE	Ratko Stanković		
13.	▪ Basics of queueing systems	L	Ratko Stanković		
	▪ Simulation of XD terminal 2	AE	Ratko Stanković		
14.	▪ Parameters of queueing system	L	Ratko Stanković		
	▪ Simulation of XD terminal 3	AE	Ratko Stanković		

15.	▪ Case study: analysis of the M/M/1 system	L	Ratko Stanković		
	▪ Calculating the parameters of the queuing system	AE	Ratko Stanković		

L = Lectures; **AE** = Auditory Exercises; **LE** = Laboratory Exercises; S = Seminars

STUDENT OBLIGATIONS AND EXAMS

Conditions for obtaining a signature (acquiring the status Completed course)

The condition for signature is activity in class and submission of the Project assignment via the e-student portal, which is accepted by the teacher.
It is possible to obtain a maximum of 20 points at the class activity, and a minimum of 12 points is required.
Points for class activity are earned by taking e-tests. Two e-tests are planned, each with a maximum of 10 points.

Written Examination:

Written testing of knowledge, by two colloquiums (max 40 + 40 points) or by a written exam (max 80 points).

Oral examination:

Oral verification of knowledge, by an oral exam.

Students who meet the following conditions can take the oral exam:
- Achieved at least 60 points, of which at least 48 points is obtained by colloquiums or by written exam, and at least 12 points by the class activity.
- Prepared and submitted the Project assignment that was accepted by the teacher.

LITERATURE

a) Obligatory literature:

1. Stanković R. Authorised teaching materials (pptx prezentations, xlsx files, doe and fsm simulation models) available at the e-learning portal, University of Zagreb, Faculty of transport and traffic sciences, 2023.

2. Rossetti MD. Simulation Modeling and Arena. 3rd and Open Text Edition; 2021. https://rossetti.github.io/RossettiArenaBook/ licensed under the Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License.

3. Beaverstock M, Greenwood A, Nordgren W. Applied Simulation: Modeling and Analysis Using Flexsim (5th Edition). FlexSim Software Products, Inc.; 2018.

b) Recommended literature:

1. Law AM. Simulation Modeling and Analysis (5th Edition), McGraw-Hill Education; 2015. https://industri.fatek.unpatti.ac.id/wp-content/uploads/2019/03/108-Simulation-Modeling-and-Analysis-Averill-M.-Law-Edisi-5-2014.pdf

2. Kelton WD, Zupick N, Ivey N. Simulation with Arena. 7th Edition; 2022., ISBN10: 1264162448 | ISBN13: 9781264162444 https://www.mheducation.com/highered/product/simulation-arena-kelton-sadowski/

METHODOLOGY OF THE IMPLEMENTATION OF THE COURSE PLAN

1. LECTURES

2. LABORATORY EXERCISES

3. PROJECT ASSIGNMENT

4. DOCUMENTATION

An electronic record of attendance at lectures and exercises, as well as the success achieved in the program assignment, is kept. The record is available to students via the e-learning portal of the Faculty of Transport and Traffic Sciences.

5. SCORING SYSTEM

Students' achievements during the course are evaluated based on the internal points/credits earned by participating in the class (lectures and exercises) and by the project assignment. Students must achieve a minimum of 12 points by participating in the class and obtain a positive remark for the project assignment, to be granted the status "courses requirements achieved".

Table 1 The scoring system for the monitoring of students and explained credit values in ECTS credits

no	Segment:		Required credits to be achieved:		Remark:	ECTS credits
			Min.	Max.		
1.	Presence at the lectures		12	20		**1**
2.	Presence at the exercises					**1**
3.	Project assignment					**1**
4.	First colloquium	= Written exam	20	40		**1**
5.	Second colloquium		20	40		**1**
6.	Oral exam					**1**
Σ	*Overall points:*		52	100	*Overall ECTS points:*	**6**

Table 2 - Explanation of the credit values in evaluations

CREDITS:	Estimate based on attendance, project task and two colloquies (or written exam) - [5 ECTS]	The final score [6 ECTS]
60 – 74	Sufficient (2)	
75 – 85	Good (3)	
86 – 94	Very good (4)	
95 - 100	Excellent (5)	

Information for students (scoring system, implementation plan, learning outcomes, syllabus, literature, consulting teachers, announcement of results of examinations or colloquium, and all other information):

- **https://moodle.srce.hr/2025-2026/ (https://merlin.srce.hr)**
- **http://www.fpz.unizg.hr/isvu/2025-en/**

Student assistants: