GRADUATE STUDY: ITS AND LOGISTICS

SEMESTER (III)

Syllabus

Academic year 2024/2025

Course:	**Logistics and Transportation Models**				
Head of course: Assoc. Prof. **Ratko Stanković**, Ph.D.					
Co-lecturers: Prof. **Jasmina Pašagić Škrinjar**, Ph.D.					
Semester: **W/S**	Course code: **86882**	Lectures: **30**	Auditory exercises: **0**	Laboratory exercises: **15**	ECTS credits: **5**
Group for lectures: **up to 20 students**			Group for auditory and laboratory exercises: **up to 20 students**		

Objective of the course:

- Adopting knowledge of mathematical modelling logistic problems and optimizing logistic systems.
- Developing skills of implementing linear programming and heuristic methods in solving logistic problems, by using software tools.

Learning outcomes:

After successfully accomplishing the course, students will be able to:

1. Recognize different types of logistic problems.
2. Apply basic principles of mathematical modelling.
3. Design mathematical models of logistic systems for optimization purpose.
4. Apply software tools in obtaining optimal solutions of various logistic problems (resource allocation problem, aggregate planning problem, transport problem, location problem).
5. Solve optimization problems in transport by applying heuristic methods.
6. Evaluate results of optimization obtained on mathematical models.

LECTURES and EXERCISES

Week	Syllabus	Form of classes	Performed by	Lessons	Remark
1	▪ Key aspects of logistic systems, macro and micro logistic organisations. Definition of models and modelling process in general.	L	Ratko Stanković	2	
	▪ Linear programming models, Sensitivity Analysis.	LE	Ratko Stanković	1	
2	▪ Optimization and the main principles of modelling. Implementation of mathematical models in solving logistic problems.	L	Ratko Stanković	2	
	▪ Testing of computer skills, spreadsheet optimiser (MS Excel Solver) in particular.	LE	Ratko Stanković	1	
3	▪ Resource alocation problem: ▪ Analysis and logical description of the problem, designing the mathematical model, Sensitivity Analysis of the model.	L	Ratko Stanković	2	
	▪ Converting mathematical model into spreadsheet (*MS Excel*) related to the respective example of the problem and obtaining the optimal solution by using spreadsheet optimizer tool - *Solver.*	LE	Ratko Stanković	1	
4	▪ Aggregate planning problem: ▪ Analysis and logical description of the problem, designing the mathematical model.	L	Ratko Stanković	2	

Week	Syllabus	Form of classes	Performed by	Lessons	Remark
	▪ Converting mathematical model into spreadsheet (*MS Excel*) related to the respective example of the problem and obtaining the optimal solution by using spreadsheet optimizer tool - *Solver.*	LE	Ratko Stanković	1	
5	▪ Transportation problem 1: ▪ Logical description and analysis of the problem, designing the mathematical model. Formulating further improvements of the model.	L	Ratko Stanković	2	
	▪ Converting mathematical model into spreadsheet (*MS Excel*) related to the respective example of the problem and obtaining the optimal solution by using spreadsheet optimizer tool - *Solver.*	LE	Ratko Stanković	1	
6	▪ Transportation problem 2: ▪ Logical description and analysis of the problem, introducing elements of improvement, designing the expanded mathematical model.	L	Ratko Stanković	2	
	▪ Converting mathematical model into spreadsheet (*MS Excel*) related to the respective example of the problem and obtaining the optimal solution by using spreadsheet optimizer tool - *Solver.*	LE	Ratko Stanković	1	
7	▪ Integer programming: ▪ Features of resource allocation model and transportation model. ▪ Basics of mixed integer programming.	L	Ratko Stanković	2	
	▪ Converting mathematical model into spreadsheet (*MS Excel*) related to the respective example of the problem and obtaining the optimal solution by using spreadsheet optimizer tool - *Solver.*	LE	Ratko Stanković	1	
8	▪ Capacitated Location Problem: ▪ Logical description and analysis of the problem, designing the mathematical model.	L	Ratko Stanković	2	

Week	Syllabus	Form of classes	Performed by	Lessons	Remark
	▪ Converting mathematical model into spreadsheet (*MS Excel*) related to the respective example of the problem and obtaining the optimal solution by using spreadsheet optimizer tool - *Solver.*	LE	Ratko Stanković	1	1st Partial test
9	▪ Expanded capacitated location problem: ▪ Logical description and analysis of the problem, designing the mathematical model. Quantifying improvements achieved by optimization.	L	Ratko Stanković	2	
	▪ Converting mathematical model into spreadsheet (*MS Excel*) related to the respective example of the problem and obtaining the optimal solution by using spreadsheet optimizer tool - *Solver.*	LE	Ratko Stanković	1	
10	▪ Multy-echelon location problem: ▪ Logical description and analysis of the problem, introducing elements of improvement, designing the expanded mathematical model.	L	Ratko Stanković	2	
	▪ Designing spreadsheet tables (*MS Excel*) related to a particular example of the problem and finding the optimal solution by use of spreadsheet optimizer tool - *Solver*	LE	Ratko Stanković	1	
11	▪ Basics of heuristics and development of heuristic methods. Classification of the heuristic methods.	L	Jasmina Pašagić Škrinjar	2	
	▪ Solving of HUB – location problems by single and multiple allocation method.	LE	Jasmina Pašagić Škrinjar	1	
12	▪ Applying heuristic algorithms for solving logistic problems: traveling salesman problem.	L	Jasmina Pašagić-Škrinjar	2	

Week	Syllabus	Form of classes	Performed by	Lessons	Remark
	▪ Introduction of Concorde TSP software and solving problem tasks.	LE	Jasmina Pašagić Škrinjar	1	
13	▪ Implementation of heuristic algorithms: simulated annealing.	L	Jasmina Pašagić-Škrinjar	2	
	▪ Solving problem tasks.	LE	Jasmina Pašagić Škrinjar	1	
14	▪ Implementation of heuristic algorithms: search method with taboo list.	L	Jasmina Pašagić-Škrinjar	2	
	▪ Solving problem tasks.	LE	Jasmina Pašagić Škrinjar	1	
15	▪ Applying heuristic algorithms for solving logistic problems: Knapsack problem, Chinese postman problem.	L	Jasmina Pašagić-Škrinjar	2	
	▪ Solving problem tasks.	LE	Jasmina Pašagić Škrinjar	1	2nd Partial test

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

STUDENT OBLIGATIONS AND EXAMS

Knowledge assessment methods

During the semester students have the option of taking two partial written tests. Each partial test consists of various problem tasks, related to the teaching topics. It is possible to achieve maximum of 45 points per each partial test.

Students who achieve a total of 27 points or more at the first partial test, are entitled to take the second partial test. Students who achieve a total of 27 points or more at the second test, are exempted from the written exam. Students who do not take the partial tests or fail to achieve the required number of points have to take the written exam.

The written and oral exam is provided for all students, i.e. the oral exam is mandatory for all, but the written exam is mandatory only for students who didn't successfully accomplished the partial tests or those who are not satisfied with their achievement at the partial tests. The minimum required at the written exam is to answer 60% of questions correctly. The grading system is explained below:

a) Attendance at lectures and exercise ≥ 80%..... 10 points

b) Total of 10 points are required for obtaining the course completion signature and accession to the written exam.

c) Partial tests:

   c1) 1st partial test: minimum 27 points, maximum 45 points;

   c2) 2nd partial test: minimum 27 points, maximum 45 points;

d) Exemption from the written exam: successfully accomplished both partial tests (minimum of 54 points in total).

e) Written exam grading:
   - Less than 54 points..... fail
   - 54 – 64 points..... Sufficient (2)
   - 65 – 75 points..... Good (3)
   - 76 – 84 points..... Very good (4)
   - 85 – 90 points..... Excellent (5)

Students are required to attend lectures and exercises. Students with minimum of 80% of attendance at the end of the semester are granted 10 points, otherwise they have to enroll to the course once again. In case of justified absence (more than three times during the semester), students have to submit medical records or other official documents (which are subject to verification).

Conditions for obtaining the signature:

Minimum 80% attendance at lectures and exercises.

LITERATURE

a) Obligatory literature:

1. Teaching materials Stanković, R., Pašagić Škrinjar, J.
2. Shapiro, J. F.: *Modeling the Supply Chain*, Wadsworth Group, Thomson Learning Inc., Duxbury, 2001.
3. Lawrence, J. A., Pasternack, Barry A.: Applied Management Science, Jonh Wiley & Sons Inc., Hoboken, 2002.
4. Reeves, C.R.: *Modern Heuristocs Tehniques for Combinatorialn Problems, McGraw-Hill Book, 1995.*

b) Recommended literature:

1. Chopra, S., Meindl, P.: *Supply Chain Management*, Pearson Education Inc., New Jersey, 2004.

METHODOLOGY OF THE IMPLEMENTATION OF THE COURSE PLAN

1. LECTURES

Lectures correspond to the respective topics from the obligatory literature and are performed by using Power Point presentations (in English). The use of the textbook and recommended literature allows students to prepare the lecture topics in advance. Presentations and other teaching materials are published on student portal at the Faculty internet site. The students are encouraged to study the topic of the forthcoming lecture in advance and to take part in discussions.

2. LABORATORY EXERCISES

Students design mathematical models of logistic problems in spreadsheet tables (MS Excel) and obtain the optimal solution by use of the spreadsheet optimizer tool. At exercises, students use descriptions and elaborations of the problems developed during the lectures (mathematical models). Exercises are performed in PC - Lab.

3. DOCUMENTATION

Students attendance record is kept during the semester. Students achievements are recorded by continues monitoring in the information system ISVU. All tests are kept in lecturer's file for one year.

4. SCORING SYSTEM

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.	Attendance at the lectures and exercises	10	10	Minimum 80%	**1**
2.	1st partial test	27	45	Not mandatory, but is alternative to the written exam	**1**
3.	2nd partial test	27	45		**1**
4.	Written exam	54	90	Mandatory unless both partial test successfully accomplished	**2**
5.	Oral exam			Mandatory	**2**
Σ		**64**	**100**		**5**

Table 2 - Explanation of the credit values in evaluations

CREDITS:	Estimate based on attendance and two partial tests or written exam alternatively [3 ECTS]:	The final score [5 ECTS]:
64 - 74	Sufficient (2)	Total of 5 ECTS are gained if a student successfully accomplish the oral exam. Final grade is defined based on overall student achievements (attendance at lectures/exercises, written part and oral part of the exam)
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 tests, and all other information):

- **https://moodle.srce.hr/2024-2025/**
- **http://www.fpz.unizg.hr**

Student assistants: Additional individual work with the students through individual consultations, as well as for insight into the written part of the exam.