UNDERGRADUATE STUDY: TRANSPORT

SEMESTER (VI)

Syllabus

Academic year 2023/2024

Course: **Railway Timetabling and Operations**						
Head of course: Assoc. Prof. **Hrvoje Haramina**, Ph.D.						
Co-lecturers:						
Semester: **VI**	Course code: **74185**	Lectures: **30**	Seminars: **10**	Auditory exercises: **20**	Laboratory exercises: -	ECTS credits: **6**
Group for lectures and seminars:				Group for auditory and laboratory exercises:		

Objective of the course:

- The course aims to introduce students to the principles of railway operations, timetable planning and construction.

Learning outcomes:

At the end of the course students will:

1. be able to explain basic principles of railway traffic control
2. know basic principles of railway planning and timetabling
3. be able to assess a railway line capacity
4. know how to check feasibility and stability of railway timetables and to evaluate how disturbances affect railway operations

LECTURES, EXERCISES and SEMINARS

Week	Syllabus	Form of classes	Performed by	Lessons	Remark
1.	▪ Introduction to the area of railway timetabling ▪ Basic principles of train and traffic control	L	Hrvoje Haramina	4	
2.	▪ Timetable design principles ▪ Diagramming traffic ▪ Principles of train separation ▪ Calculating blocking times ▪ Headways and buffer times	L	Hrvoje Haramina	4	
3.	▪ Cyclic timetabling ▪ Train running time estimation	L	Hrvoje Haramina	4	
4.	▪ Analysis of railway timetable documents	AE	Hrvoje Haramina	4	
5.	▪ Routing trains through railway stations ▪ Station intervals	L	Hrvoje Haramina	4	
6.	▪ Calculation of station intervals	AE	Hrvoje Haramina	4	
7.	▪ Energy-efficient railway operation and timetabling	L	Hrvoje Haramina	4	
8.	▪ Calculation of station intervals ▪ Calculation of train headways	AE	Hrvoje Haramina	4	

9.	▪ Timetable rescheduling process	L	Hrvoje Haramina	4	
10.	▪ Case study - Calculation of train headways on railway lines equipped with different train control system	AE	Hrvoje Haramina	4	
11.	▪ European Rail Traffic Management System (ERTMS)	L	Hrvoje Haramina	4	
12.	▪ Modelling of train paths	S	Hrvoje Haramina	2	
13.	▪ Simulation analysis of timetable stability	S	Hrvoje Haramina	4	
14.	▪ Railway infrastructure capacity analysis	L	Hrvoje Haramina	2	
	▪ Railway line capacity assessment (UIC 406 method)	S	Hrvoje Haramina	4	
15.	▪ Increasing line capacity with constant infrastructure	AE	Hrvoje Haramina	4	

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

STUDENT OBLIGATIONS AND EXAMS

Conditions for obtaining signatures:

Attendance is mandatory and students are required to attend at least 80% of the classes. In addition, at the end of the course students are required to write and present their seminar paper and to oral examination.

Oral exam: Students are required to answer questions in such a way to demonstrate sufficient knowledge of the subject matter in order to pass the oral exam.

Documentation:
Attendance list is signed by students prior to every lecture.

LITERATURE

a) Obligatory literature:

1. I.A. Hansen, J. Pahl: Railway Timetable & Traffic – Analysis – Modelling - Simulation, EURAIL PRESS 2008.
2. UIC Code 406, Capacity, International Union of Railways (UIC), 2004.

b) Recommended literature:

1. J. Pachl: Railway Operation and Control 3nd edition, VTD Rail Publishing, Mountlake Terrace(USA), 2009.

METHODOLOGY OF THE IMPLEMENTATION OF THE COURSE PLAN

The curriculum is conducted through lectures, exercises and a seminar.

1. LECTURES

In the course of the lectures the theoretical framework of the curriculum is presented and followed by practical examples.

2. EXERCISES

In the course of exercises students are required to practice diverse calculations solving challenges in order to define all necessary parameters for a railway timetable construction.

3. SEMINARS

In the course of the seminar an example of a simulation analysis of timetable stability and railway line capacity assessment through application of UIC 406 method is presented and discussed.

4. DOCUMENTATION

Attendance list is signed by students prior to every lecture.

5. SCORING SYSTEM

Table 1 Explanation of the credit values in evaluations

Activity	ECTS credits
Lectures	**2.5**
Oral exam	**2**
Seminar	**1.5**
In total**:**	**6**